Welding Engineer

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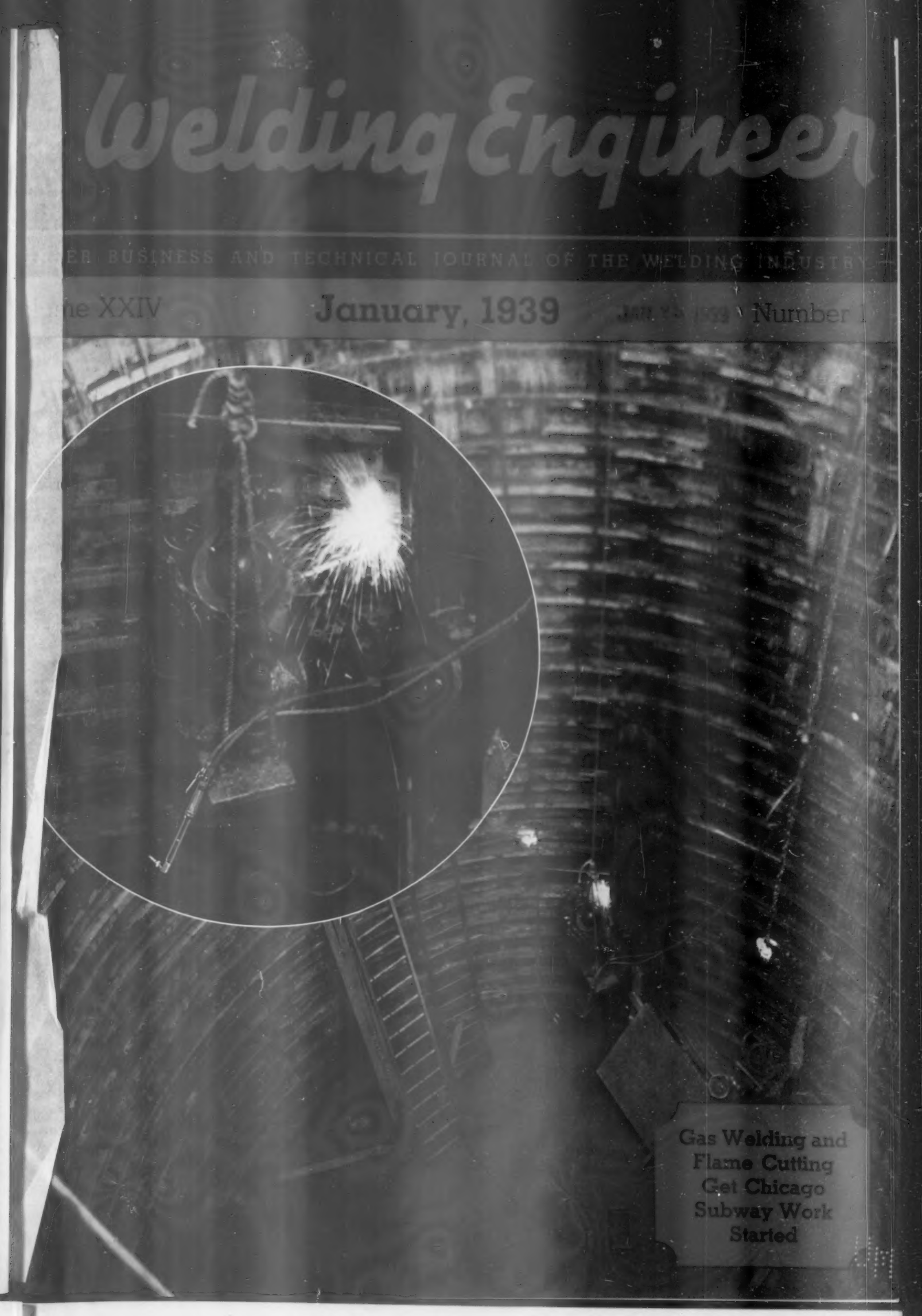
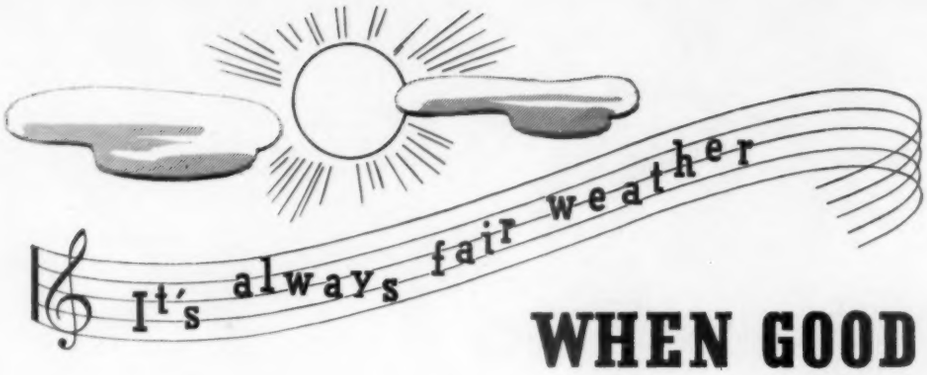
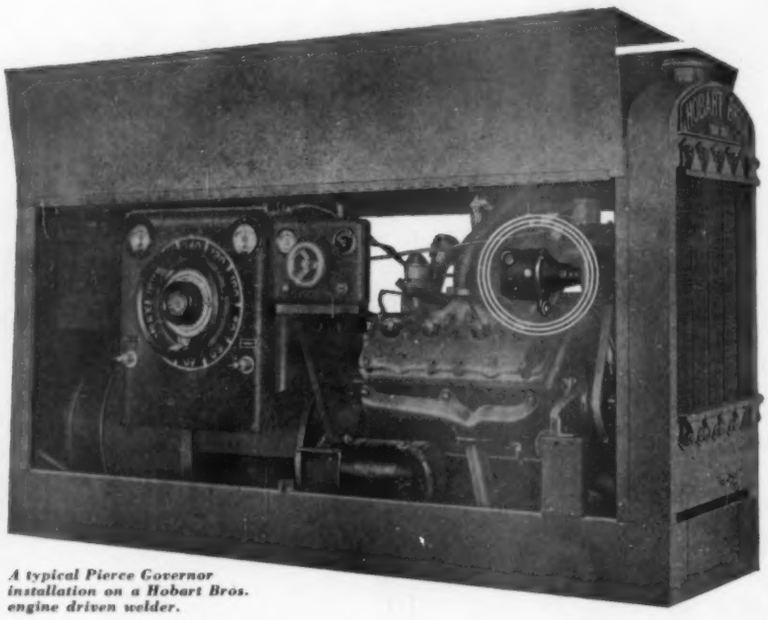


Gas Welding and Flame Cutting Get Chicago Subway Work Started



WHEN GOOD PRODUCTS GET TOGETHER



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Eastern Representative:
T. E. DEPEW, 1834 Broadway, New York, N. Y.
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—A progress photograph of construction work on entrance shaft for initial system of subways. Photo, courtesy of The Bastian-Blessing Co.

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Welding Industry Looks Ahead

RECENTLY, WE ASKED Harry Boardman what he believed to be the most important problems affecting the progress of the welding industry. As most of our readers know, Harry Boardman is currently president of the A.W.S. and research engineer of Chicago Bridge & Iron Co. Here, in Mr. Boardman's opinion, are the important needs of the industry:

(1) Fewer and better codes. Two or more codes covering a similar type of construction are not at all uncommon. For example, there are the A.S.M.E. and A.P.I.-A.S.M.E. codes for pressure vessels; and the A.W.S. and A.P.I. codes for oil storage tanks. This condition causes confusion and needless expense. Relieving efforts are under way. A committee is now working to combine the A.S.M.E. and A.P.I.-A.S.M.E. pressure vessel codes; another committee is planning to iron out the differences between the A.W.S. and A.P.I. oil storage tank codes and issue one code in place of both; and still another committee is preparing a joint A.W.S. and A.W.W.A.* code for elevated tanks.

(2) A good set of rules under which any manufacturer can set up and qualify his own welding procedure, thus making possible and encouraging the very desirable practice of omitting from construction specifications all requirements as to forms and dimensions of grooves, and specifying only the quality of the finished joint. Part I of the A.W.S. Standard Qualification Procedure goes far towards meeting this need, and has already been made a part of several codes. Its further use should be encouraged.

(3) A universal and simple, yet adequate, set of qualification tests for welding operators. Part II of the A.W.S. Standard Qualification Procedure provides a tentative set, the ultimate value of which, practical use only can establish. The outstanding feature of this operator test is the use of "guided bend" tests for butt welds, instead of tension or nick-break tests.

(4) A filler metal specification of such merit that qualification under it will be universally acceptable. The N.E.M.A., A.W.S., and A.S.T.M. groups are working on this problem.

(5) Reliable data on the conditions under which locked-up stresses, due to mild steel welding, may be safely ignored, and of conditions under which they should be considered in design. Information about stress corrosion in the presence of certain liquids and gases is urgently needed.

(6) Specific data as to the value of hammer testing of welded vessels.

(7) An available supply, at reasonable cost to all fabricators, of mild steel plates of commercial sizes and thicknesses, veneered with chrome and chrome-nickel linings. There is reason to expect that this demand will soon be met.

*American Water Works Association.

"Reciprocal Relations" Department

By JAMES F. LINCOLN

UNDER THE ATTACK on business by the present administration we manufacturers like to feel that we are martyrs. We know the attack is unjustified, in general. Government, however, has uncovered some abuses which are real enough to justify action in some cases. One of these abuses which, as yet has not been the subject of regulation, but which will, and perhaps should be, is that of reciprocal buying. This exploded theory is continued only because of its age, not because anyone in industry finds it a satisfactory method of placing business.

Industry, at great expense, sets up a purchasing department, an inspection department and an engineering department, to produce material of proper price and quality. After having done this they put in a "reciprocal relations" department which overrides the decisions of the buyer, the inspector and the engineer, and places business merely because of reciprocity, which results in frequent strained industrial relations, since no one can buy in a volume to satisfy the reciprocator. Not only that, but the distribution is never fair from the seller's point of view.

Reciprocal buying results in higher prices, since the reciprocator cannot get the best price available. It results in lower quality since the reciprocator cannot insist on quality. It results in lack of standardization which enormously increases the cost of upkeep.

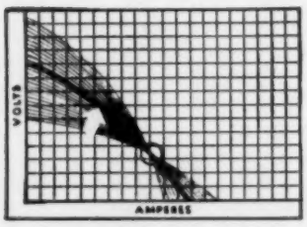
The worst of it is that in this case the government would have a perfectly clear case to prove its point. No one could take the untenable position that reciprocal buying is anything but asinine and wasteful. However, in the hands of governmental regulation for its elimination, a waste will be turned into regimentation from which industry perhaps can never recover.

PLUGGING FOR PROGRESS WITH POP AND LAD

HOW TO *DIG* FOR LOWER WELDING COSTS

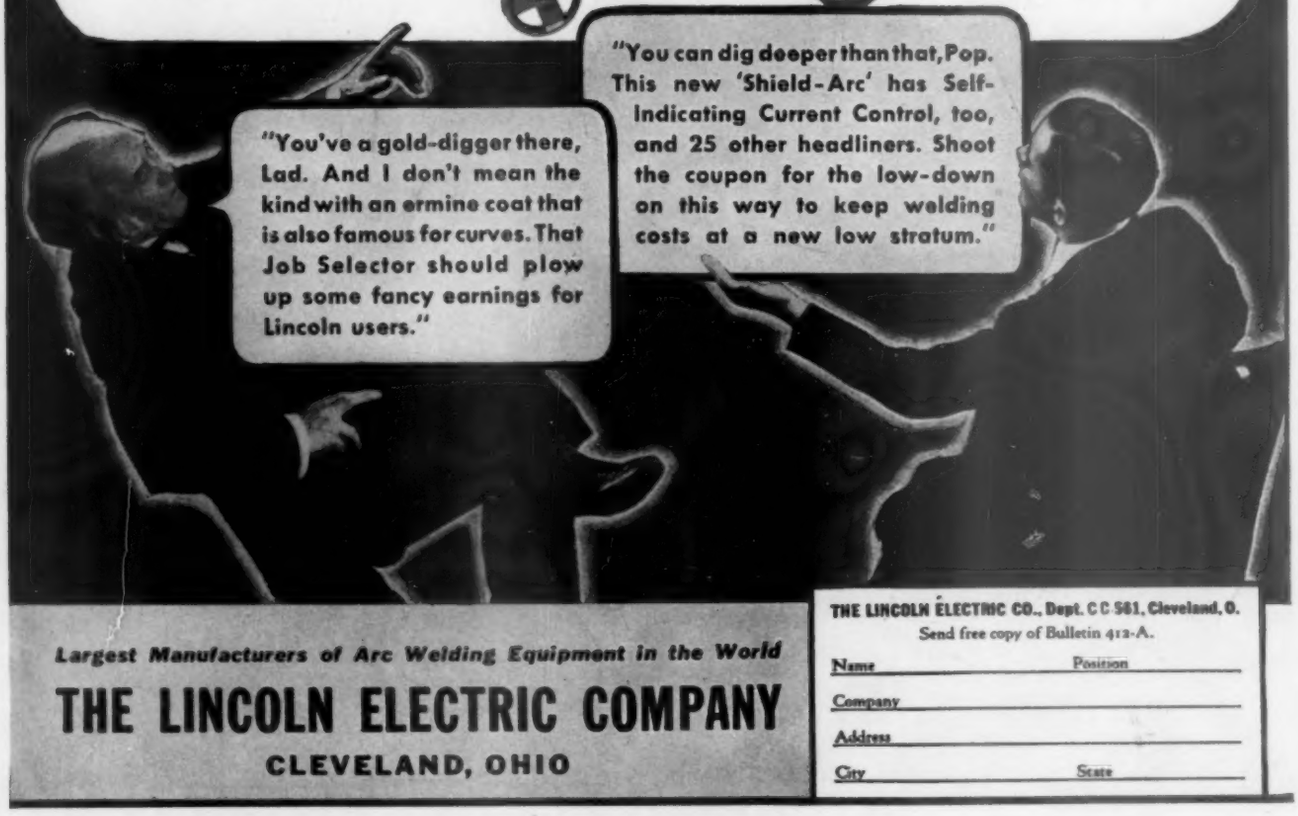
(A) HERE IS THE JOB
Building a barge. Welding bottom plates. Overhead position.

(B) HERE IS "SHIELD-ARC'S" JOB SELECTOR SETTING
This gives a curve as shown in (C). It is Self-Indicating.



(C) HERE IS THE VOLT-AMP CURVE
Its gradual slope gives an arc whose current increases as the arc is shortened.

(D) RESULT: A DIGGING ARC
Sticking is eliminated. Spatter is minimized. Welds are smoother and stronger. COSTS ARE CUT.


"You've a gold-digger there, Lad. And I don't mean the kind with an ermine coat that is also famous for curves. That Job Selector should plow up some fancy earnings for Lincoln users."
"You can dig deeper than that, Pop. This new 'Shield-Arc' has Self-Indicating Current Control, too, and 25 other headliners. Shoot the coupon for the low-down on this way to keep welding costs at a new low stratum."

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Making the first pass on 6 in. casing. Two H. C. Price Co. welders working simultaneously 180 deg. apart. Photo (Lincoln Electric Co.).

Welding processes are vitally important in

Oil Field Production

★ Arc welded casing procedure—Both arc and gas welding of line pipe—Equipment builders favor welded fabrication

WELDING and cutting processes play a vital and increasingly important part in the huge petroleum industry. In this brief article we attempt to sketch the applications of the welding arc and welding blowpipe in the first stage of the attack on Mother Earth to force her to give up some of her hidden wealth, in the form of "black gold." Oil field production makes use of welding to hard face drilling bits, to join casing pipe into long strings, to weld line pipe for gathering the crude oil and to carry it long distances to refineries, where it is processed into various fuels and lubricants. These manufactured products keep the wheels of industry spinning and power nearly 30 million automobiles and motor trucks and speed thousands of busy people along aerial highways at 200 to 300 m.p.h.

One of the most active oil production fields at the present time is the Illinois Basin field as shown in the small map of Southern Illinois. Several large oil producing companies are busily engaged in drilling wells and getting leases into production. One of these, Carter Oil Co., is a pioneer in the development of field welded casing to supplant the older method of threaded casing.

Welding of Casing

H. C. Price Co. has established field headquarters at Effingham, Ill., with E. J. Roth, welding foreman in charge. The field organization furnishes 24-hour service with nine welders, six helpers, one mechanic and one night man. This company has a contract with the Carter Oil Co. to handle the field welding of oil well casing in their territory, which is in vicinity of St. Elmo, Ill. Only one string of casing is run in the fairly shallow Illinois wells, using 6-in. O.D. seamless steel casing manufactured by National Tube Co. This casing has a ¼-in. wall and

Map of Illinois Basin field which is experiencing intensive drilling development at present time.

Welding cement shoe at bottom of first section of casing. Device has valve to prevent cement from backing up into casing after it has been pumped through into hole. Photo (Lincoln Electric Co.).

weighs 14.64 lbs. per lineal foot. This casing is prepared at the mill with a concave groove, leaving approximately a 1/16-in. shelf where the casing is butted together.

Experience of H. C. Price Co. indicates that the average time to complete a joint in 6-in. casing is 3½ min. With an average depth of 1500 ft., the over-all running time is about 3½ hrs. As noted in the illustrations, two operators work simultaneously and approximately in opposed position, that is, 180 deg. apart. Using a 3/16-in. No. 5 Fleetweld rod with about 200 amp., the operators first apply about four tack welds. This enables the line-up clamp to be removed. Next operation is to run the first bead, each operator endeavoring to keep 180 deg. from his partner. When the first bead is completed, another member of the gang with an electric hammer peens the bead, principally to remove the slag coating. Next, the two operators return to the casing and apply a second and final bead. About one minute of time is allowed after the arc is broken on the second bead, before the string of casing pipe is lifted by the derrick tackle, the wedge clamps removed and the casing lowered into the hole. In other words, before the weld is quenched, it is subjected to the full dead weight of the casing string. Furthermore, as if this was not enough abuse, the weld is quenched while under load. Of course, the first welds do not have to withstand much stress, but when they have to support about 1500 ft. of casing, the weld stress is fairly high before the weld is quenched.

Casing welders have to be available 24 hrs. a day. Photo taken at sundown (Welding Engineer).

Over 200 casing strings have been welded in the Carter Oil Co. field up to the time this article was written. One of the photographs shows the type of welding equipment used by H. C. Price Co. Each truck carries two gas engine-driven 300 amp. Lincoln welders, together with necessary line up and pick-up clamps, electrode holders, helmets, etc. These trucks are driven right up to location, each operator hav-

Removing slag coating (first bead) with electric hammer energized by exciter on welding generator. Photo (Lincoln Electric Co.).

Completing the second pass. Slips in rotary table hold string of casing during welding. Photo (Lincoln Electric Co.).

Drilling crew pumps mud into casing to resist collapse pressures. This is done every 8 or 10 joints. Photo (Lincoln Electric Co.).

One of H. C. Price Co. crews "on location." Photo (Lincoln Electric Co.).

Very simple line-up clamp for 4-in. pipe.

Simple line-up clamp used in tack welding of casing. At lower right is pick-up clamp used to hoist casing lengths at the derrick.

ing his own gas engine unit when welding casing.

Arc Welded Pipelines

Along with drilling of wells, sinking of casing, oil field activity includes welding of gathering lines and truck lines to handle the crude oil. Several illustrations show work conducted by Williams Bros. Corp., pipeline contractors, in the Texas Co. field near Lake Centralia, which is southwest of Salem, Ill. This particular line is a 4-in. gathering line. The joint has a 22½ deg. bevel with a very thin shoulder. The first step, as shown in the sequence of illustrations, is the line up of the pipe with the simple clamp shown. Next, the operator places about 3 tack welds using a 5/32 in. No. 5 Fleetweld rod and about 150 amp. of current. The line-up clamp is then removed and one operator completes the pipe weld, generally working up from the bottom.

All of the welding on this 4-in. line is done by the stove pipe method, which welds each pipe section in "position." However, the pipe is suspended above the trench until welding is completed so that the bell hole weld is fairly easy to make. The oxy-acetylene cutting torch is an indispensable tool for the pipeline welding crew. The pipe, which is shown being cut with a torch, was first bent to the proper angle so that the full leverage of the pipe section could be utilized. The operator cut the pipe with the proper welding bevel.

Gas Welded 10-in. Pipeline

A 10-in. pipeline recently completed for the Northern Indiana Pipe Line Co. in East Chicago, Ind., connects the Sinclair Refining Co. and Wadhams Oil Co. refineries with the pipeline company's trunk line. This line is approximately 8 miles long and was built by the "stove pipe" method at a saving of 50 per cent under the older method.

Operator makes about 3 tack welds.

Cutting torch is an indispensable tool in building oil pipelines. Cut with proper bevel for welding.

Completing the weld in 4-in. gathering line. All pipe welded to line by "stove pipe" method.

Toggle clamp is used to hold pipe sections together for tack welding.

In the "stove pipe" method, successive lengths of pipe are welded on to the string, all welding being in position and in the "bell-hole," as shown in the illustrations.

The older method involved "rolling" welds of several sections of pipe before they were placed in the trench.

The pipe was prepared at the mill with a 40-deg. bevel and a ⅛-in. shoulder. This is a wider bevel than would have been necessary for multi-flame Linde welding. An Oxweld blowpipe (Type W-22) with a No. 12 Single Flame tip was employed in welding the pipe joints. Using a 7/32 in. Oxweld Type 32-CMS welding rod, the average time per joint was about 10 minutes. This is a high carbon rod which gives the joint a tensile strength equal to that of the pipe section. The con-

Making a "bell hole" weld on "stove pipe" constructed 10-in. line.

tractor, Cities Construction Co., Hammond, Ind., used acetylene generators mounted on portable trailers to generate acetylene in the field, at a substantial saving in cost.

For electrolysis protection, this line is provided with insulated flanged couplings every 1500 to 2000 ft. This is necessary because the pipeline crosses several street railways and earth currents flowing through the pipeline

Making the first pass on 10-in. pipe, using 7/32 in. high carbon rod. Average time per joint, about 10 min.

Cold bent pipe (10-in. line) demonstrates ductility and tensile strength of gas welded joints.

would rapidly deteriorate it. Where the line crossed the Grand Calumet River, it was encased in concrete of 1½ in. thickness.

It is evident that manufacturers of oil field equipment have adopted welding on a big scale. Anyone who visits the oil fields will notice that the oil pumps are invariably of welded construction. An illustration shows a

Most of the pump makers use welded construction. This National pump is typical of many to be found in the oil country.

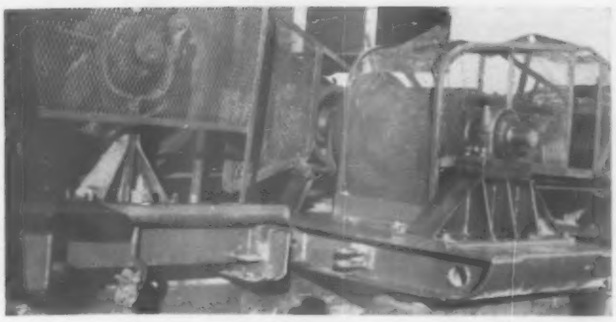
walking-beam type of oil pump manufactured by National Supply Co. The various elements of the pump structure are fabricated of simple structural sections.

The draw works (for well drilling) are generally mounted on welded skids. An illustration shows the welded construction of a draw works assembly used by a contractor drilling for Carter Oil Co. These heavy skids permit the contractor to transport his equipment direct to location by pulling with a tractor. This heavy equipment has to be moved sometimes under very unfavorable conditions. A tractor and a skid is about the only method of transportation that will work.

The derrick structure has to be bolted because it is generally dismantled after the well is completed and the pump placed in operation.

Holder Welding Co., St. Elmo, Ill., has set up a small portable field repair shop near the principal scene of activity in the Carter Oil Co. field. One

Arc welding No. 12 gauge metal into a fuel tank for a diesel-driven drilling rig.



Drilling contractors prefer welded rigs because they can withstand the toughest kind of service.

This oil field welding specialist uses the oxy-acetylene torch to build diesel engine fuel tanks.

of the illustrations shows Mr. Holder with an oxy-acetylene torch, welding a diesel engine fuel tank for a drilling rig. Mr. Holder received an order to build 20 of these fuel tanks to replace tanks made of too light material to withstand the severe vibration encountered in oil well drilling service. The tanks built by Mr. Holder were fabricated of No. 12 gauge sheet metal. In order to speed production his partner also went to work on the job using his General Electric arc welding machine.

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Welded Pipe Flanges Reduce Weight and Eliminate Drilling

By GEORGE B. CRAMP*

★ In the development of necks and flanges for application or connection to steel piping by welding, design has followed closely the past designs of threaded, faced and drilled flanges. Several good reasons exist for a much needed departure from this practice.

First, the threaded flange, if welded to the pipe, is no longer a threaded, or screwed flange in the sense that it can be unscrewed again from the pipe, as welding it thereto precludes such a possibility. Second, the heavy full-faced flanges, if not held in alignment by threading or other provisions, will, during the welding operation, often become warped so that the face of the flange will not be parallel to the mating flange and must consequently be refaced. Third, if two welds are applied in fastening the flange to the pipe, the second being applied to correct or overcome the warping effect of the first weld on the flange, then double the amount of welding and time is expended than is economically necessary for welding a flange to a pipe.

The type of welding flanges here described and shown in detail in Fig. 1, overcomes the foregoing objections and design faults of the common type of welding necks and flanges and provides important design features.

*Associate Engineer, Mechanical Design Division, U. S. Bureau of Reclamation, Denver, Colo.

Advantages of New Design

(1) The flange ring or band is made of a simple rolled section of just sufficient width to accommodate the welding of the bolts to the flange-band and of a thickness just slightly in excess of the gage thickness of the pipe to which it is to be welded.

(2) The flange ring in section has a beveled edge produced in rolling the section, which provides a recess for weld metal of sufficient section to accomplish full strength welding of the flange band to the pipe with the most economic type of weld, allowing for some facing of the weld metal when the weld occurs on the face of the flange.

(3) This combination of a band with bolts welded thereto, accomplishes the bolting together of two flanges without applying bending stresses of any appreciable amount in the flanges. The flange axis lying parallel to the pipe rather than at right angles to it, as with the common type of flange, the clamping force is a direct compressive force in line or parallel with the axis of the pipe and the resultant pressure applies a much greater unit compressive force on the relatively small flange face and gasket, thus making for a much tighter joint than is possible with the common wide-face flange connections.

(4) The flange bolts are special forgings and are specially designed for each size and strength of pipe. The T-shaped heads of the bolts are provided on the side adjacent to the flange band surface with bevels for welding the bolts to the flange. When the bolts are properly spaced on and welded to the flanges the adjacent heads of two bolts on one flange provide a space through which projects the bolt end of an opposite or mating flange and the heads of the two bolts and the ledge of the flange form three points of support for the nut of the bolt projecting between the two heads. Thus the equivalent of a bolt hole is provided for each bolt without the necessity of bolt holes having to be drilled.

(5) By this arrangement a flange connection is made to a pipe without the use of any equipment or tools except that required for welding and for light-facing-off operations. Thus all threading and tapping dies and machines, drills and heavy facing-off machines are eliminated.

(6) Such flange connections are made with the least amount of mate-

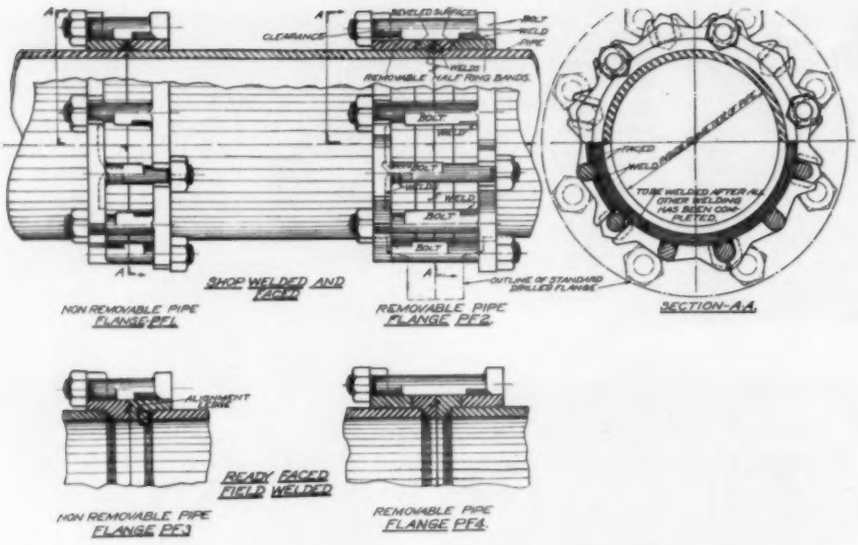


Fig. 1—Novel design of welded flange for pipe joint. Employs a band with bolts welded thereto. Minimum bending stresses set up when bolts are tightened.

rials, ordinary plain flange connections of the improved design weighing less than half that of a plain companion flange connection.

The flange diameter is greatly reduced in the improved flange so that a line of pipe may be placed in a much smaller space or trench, or several pipes may be arranged more closely together.

Several Types Possible

The principle of design is applicable to several types of flanges for various uses and applied in different ways. The drawing shows two groups of these. One group is titled "Shop Welded and Faced" and the other "Ready Faced Field Welded." Under the former group is shown a non-removable pipe type of flange. This flange is for use on runs of pipe where the joints or lengths are seldom removed. With this flange the joints, sections or lengths of pipe would be laid one length after another much as bell and spigot pipe is laid and when a line of pipe is so laid a length of pipe cannot be removed from the line without backing off the line ahead or behind the joint to be removed.

As shown in detail *PF1*, the non-removable pipe flange bolts are welded to the flange ring band and this band in turn is welded directly to the pipe so that when two sections of pipe are brought together, the bolts interlock much as do the fingers of the right and left human hand when clasped, and which cannot be drawn apart other than lengthwise of the fingers.

For a removable pipe length the flange is almost identical to the flange just described, but is not welded to the pipe, being a loose ring or two half rings. If a full ring type is used it is slipped onto the pipe before welding on the welded ring of the flange. If it is made in half rings they may be placed on pipe at any time. The loose full or half rings have a beveled surface adjustment to and matching a similar surface on the small ring band that is welded to the pipe. When the bolts of the flange are in place and the flanges aligned and the nuts tightened, these beveled surfaces tend to cause the bolt band to hug the pipe and prevent its being loosened by vibration.

Both of the foregoing types of flanges are for application in the shop where, after welding, the flanges are required to be faced off by a light facing-off operation as the weld is applied on the face of the flange and would be too rough for use without facing.

Field Welded Flanges

For use in field welding, or where no facing-off facilities are available the two flange designs as shown marked *PF3* and *PF4* are provided. These flanges would be closed rings ready faced to be slipped on the pipe in the field. The beveled edge rolled on the flange when it is produced is so placed in these two designs that the weld occurs inside the pipe and away from the face of the flange so that no facing of the flange is required after welding in the field. The same features possessed by the shop welded and faced flanges (above described) are also incorporated in the ready faced field welded flanges. One design is for a non-removable pipe and the other is for a removable pipe.

Section *A-A* on the drawing shows the T-head bolt arrangement on the ring band flange. The bolts are possible of arrangement so close to the pipe that the nuts are just clear of the outside surface of the pipe. As each alternate bolt is tightened by a nut on opposite sides there is ample wrench clearance. Should a bolt head design be required that would give full four-point support to a nut, then the alternative four-point nut support bolt head design as noted and shown in Section *A-A* may be provided.

It will be noted that the bolt circle of the improved flange is much smaller in diameter than for an equivalent flange of standard design, shown outlined in light lines in Section *A-A*. This outline also shows the outside bounds of a standard flange.

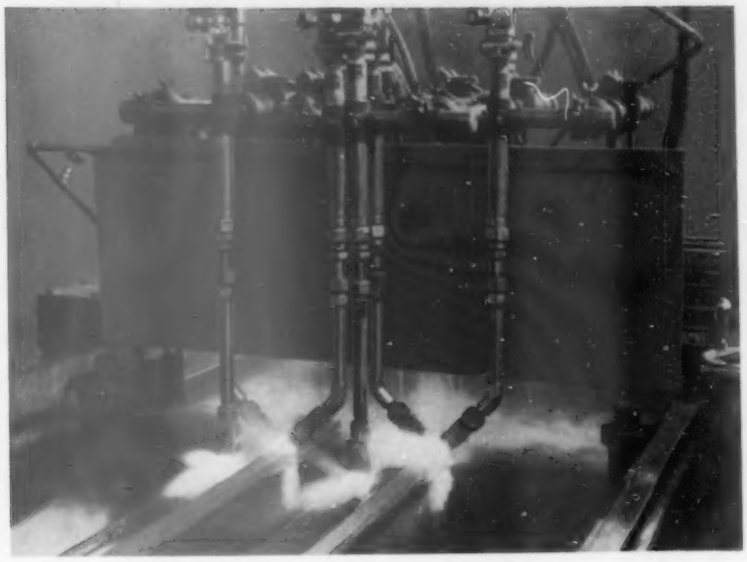
Weight Comparisons

The weight of metal removed in drilling a pair of standard 6-in. companion flanges is about two pounds. The weight of weld-metal required to weld a pair of welded flanges of improved design to their respective pipes and the bolts to their flanges is also about two pounds.

The weight of a pair of standard 6-in. cast-iron companion flanges is 40 lbs., including the weight of eight ¾-in. bolts required. The weight of a pair of plain 6-in. welded flanges of improved type would be 18 lbs., including the 12—⅝-in. bolts required. It therefore requires the use of 122 per cent more material by weight, to produce a pair of standard 6-in. companion flanges with bolts, than is required to produce a pair of the improved welded flanges of the same nominal size.

» «

FABRICATED STEEL OUTLOOK—During the first 11 months of 1938 the fabricated structural steel industry produced 1,077,000 tons. It is estimated that total production for the year 1938 will amount to at least 1,200,000 tons. This compares with a production of 1,628,641 tons during 1937. New contracts now being received by the industry indicate a consistent increasing business, which is likely to extend over the next 12 months if present indications have any significance.



Flame hardening the V's and flat ways of a machine bed. Multi-flame set-up hardens to minimum depth of ⅛ in. Photo (Air Reduction Sales Co.).

Opportunities presented to experienced welding men in

Flame Hardening Applications

★ Several advantages over other methods of surface hardening — Types of steels which can be flame hardened—Specialized equipment used

By JOHN SHEPPARD*
Chief Metallurgist, Kelsey-Hayes Wheel Co., Detroit, Mich.

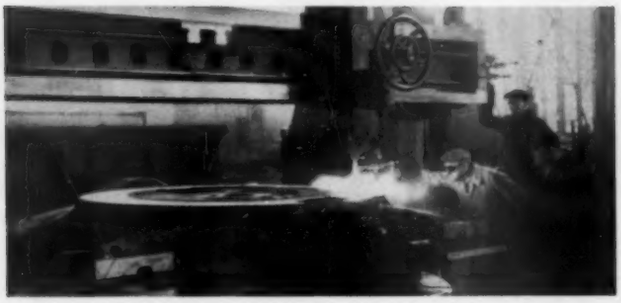
FLAME HARDENING has been appropriately defined as the process wherein the surface of a ferrous metal capable of hardening by heat treatment is locally hardened by rapidly heating to a temperature above the critical point with an oxy-acetylene flame and then quenching from that temperature. This results in a hard wear-resistant surface with a core which has not undergone any thermal change and, therefore, retains all its original toughness and ductility. There is no chemical change in the hardened surface and the process must, therefore, be differentiated from case hardening, Chapmanizing carburizing or nitriding, and other processes in which the surface composition is changed to render the material more hardenable.

The method is not new, the literature dating back almost to the first application of the oxy-acetylene flame to steel welding, where hardening of the metal adjacent to a weld in medium carbon steel was observed. Recently, however, the development of suitable mechanically operated water-cooled tips and torches which insure accurate control and dependable operation have given impetus to the use of the flame hardening process in industry. The hardening effect obtainable is similar to controlled atmosphere furnace hardening practice provided that the material has been heated to the same temperature in each case. The hardness can be tempered as required by a second and more gentle heating.

Machine designers are often confronted with the problem of selective wear of machine parts which often relegates a machine to the scrap heap through failure of one or two parts, while the body is still intact and serviceable. Replacement wear plates or liners of hard metal are inserted at points subject to selective wear, presenting a hard surface to concentrated frictional load and permitting the body of the machine to be made ductile and shock resistant.

Case hardening by the addition of carbon to form a thin hard layer on selected areas is a very old technique. It necessitates heating the part to 1600-1700 deg. F. and holding for approximately one hour for each 0.010 in. depth of case desired, followed by quenching. This results in severe distortion which limits its application to

*Paper presented at 1938 annual meeting, A. W. S., Detroit, Mich.



Flame hardening circular bearing track of steel crane car body. Photo (Air Reduction Sales Co.).

small and simple shapes, and where selective case hardening of definite areas such as the contact surface of gear teeth is required, an elaborate and costly operation of electroplating the areas to remain uncarburized must be employed.

The materials used in machine construction, medium carbon steels, semi-steels and alloyed cast irons are capable of being hardened by suitable heat treatment. Such furnace hardened parts have been commonly used as tools or inserts in machines and the hardening procedures for improving their wear resistance are commonly known to metallurgists. Furnace hardening suffers the same limitations as case hardening as regards the difficulty in preventing distortion in large or complicated shapes. A further disadvantage is that the hardness cannot be confined to the wearing surfaces of the part, but extends into the body of the material causing an appreciable loss in ductility and in resistance to shock.

Surface Hardening

The application of the intense heat of the oxy-acetylene flame provides a ready solution to the problem of obtaining the hardness effect of a furnace heat treatment at the wearing surfaces of a machine and retaining the necessary shock-resistant properties in the machine body.

It provides the high surface hardness of a case or carburizing treatment with the toughness of a quenched medium carbon steel. Distortion and residual hardening strains are all reduced to the minimum. The microstructure shows no sharp line of demarcation between the hardened zone and the core as often found in case hardened work. The hardened zone produced is at least two or three times the depth economically obtained by carburization and there is a tapering of the hard martensite at the surface which gradually changes through troostite and sorbite to the ductile pearlite of the core which results in complete freedom from spalling under impact or vibration.

Plain carbon steels above 0.35% carbon are readily flame hardened. The standard S. A. E. water hardening steels or low-alloy oil hardening steels can also be successfully hardened. Increasing carbon content favors higher hardnesses. S. A. E. 1040 steel will readily yield Rockwell C 52-58 (600 to 750 diamond Brinell) with a vigorous quench. Rail steels of 0.80% carbon are flame hardened to 450 Brinell with a very mild quench, rapid quenching yields a hardness of 800 Brinell equivalent to the hardness of hard-facing materials similar to Stellite.

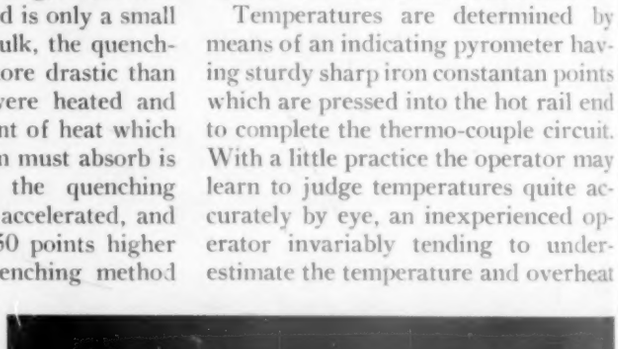
Cheap carbon steels flame hardened have been used with excellent results to replace expensive alloy steels formerly required on many applications to provide the necessary wear resistance. In flame hardening, if the surface layer being heated is only a small portion of the total bulk, the quenching action is much more drastic than if the entire piece were heated and quenched. The amount of heat which the quenching medium must absorb is so much less that the quenching rate is tremendously accelerated, and Brinell hardness of 50 points higher than the furnace quenching method is obtainable when medium heavy sections are flame hardened.

In hardening high-carbon steels in the tool steel range some care must be used to avoid surface checks from too rapid application of heat or a too severe quench. Only a fraction of the care used in furnace hardening these steels is needed when flame hardening for the tough unheated core provides an excellent support for the hardened face. Pearlitic malleable castings and low-alloy irons can all be successfully flame hardened. For many applications air hardening steels can be used which do not require any liquid quenching to obtain hardness after heating.

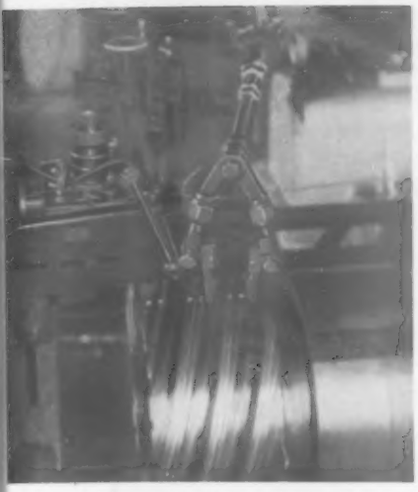
Manual Hardening

Flame hardening can be accomplished manually or mechanically. Small areas of a part can be raised to hardening heat by the application of a standard welding torch, the entire area being brought to temperature by moving the torch back and forth across the surface. The torch is removed when the operator judges that the temperature is right and the part quenched. This is the method extensively used in hardening rail ends to reduce batter. The entire width of the running surface of a rail and some four or five inches in length may be hardened in less than two minutes.

Temperatures are determined by means of an indicating pyrometer having sturdy sharp iron constantan points which are pressed into the hot rail end to complete the thermo-couple circuit. With a little practice the operator may learn to judge temperatures quite accurately by eye, an inexperienced operator invariably tending to underestimate the temperature and overheat



How an internal diameter is flame hardened with a special 3 in. tip. Photo (Air Reduction Sales Co.).



Flame hardening a spiral thread screw, using gear tooth hardening tips and Airco Radiagraph. Photo (Air Reduction Sales Co.).

the work. The degree of hardness produced can be controlled by regulating the volume of quench water. Results can be verified by means of a portable Brinell tester.

Automatic Operation

In hardening extended areas such as the entire rail length or the wearing surface of the bed of a lathe, the hardening process is made continuous by incorporating both heating and quenching functions in the hardening tip, and providing means for moving the tip at a constant speed along the path to be hardened. Heating is accomplished by one or more rows of small oxy-acetylene flames followed closely by a row of quenching holes. While water is the most common quenching medium, air and in some cases nitrogen are used.

The tip progressively heats the surface along the path of travel to hardening temperature, the quenching stream followed closely imparts a uniform hardness to the area covered by the tip travel. Multi-flame tips must be water cooled to prevent overheating of the torch and flash back of the heating flames. Tips 5 in. in width have been made for hardening wide areas, but it is usually more practical to use narrower tips, 3 in. in width and under, and to harden the surface in successive strips.

Auxiliary water jets are applied at the ends of the rows of heating holes to prevent flow of heat into areas already hardened. The soft line between two successive passes can be made so fine that it cannot be detected with the standard Brinell tester. The speed of tip travel may vary from 3-12 in. per min. depending on the size and number of heating holes and determines penetration of hardness. Usual speed is 6-8 in. per min. for ⅛ to 3/16 in. penetration. The degree of hardness obtained is regulated by the nature and volume of the quenching stream.

To provide for accurately controlled speed of motion of the hardening tip over the object surface, the torch can be mounted on a standard oxy-acetylene cutting machine. The desired speed falls within the range obtainable with these machines and they are thus ideal traversing devices. The tool post of a lathe with variable feed can also be used as a torch holder. All that is demanded is a steady rate of progress of the tip at a fixed distance above the work. Cylindrical surfaces 6 in. or more in diameter are hardened by mounting the object on the spindle of a lathe and fixing the torch in the lathe tool post. The peripheral speed of the surface to be hardened should be similar to the speed of travel over flat surfaces given above. Both internal and external surfaces of a cylindrical object can thus be hardened by progressive heating and quenching in one revolution. A row of water jets closely preceding the flames prevents drawing of the hardness at the completion of the circle.

Application to a fairly large gear in a steel mill. Photo (W. S. Bidle Co. and Air Reduction Sales Co.).

Close-up of automatic water quench in flame hardening of gear teeth. Photo (W. S. Bidle Co. and Air Reduction Sales Co.).

Cylindrical shafts of extended length are hardened by rotating the shaft on a lathe spindle with the torch mounted in the tool post. The torch is fed slowly along the length of the shaft, the relative motion of the hardening tip being spiral to the shaft axis. As in hardening successive flat strips, auxiliary quenching steams are used to avoid drawing the hardness of treated areas.

Cylindrical Surfaces

Cylindrical surfaces either internal or external, less than 6 in. in diameter are treated by spinning at 150 to 300 rpm. in front of the water cooled multi-flame tip. If the path to be hardened is too wide to cover with one tip several tips are employed. When sufficient time has elapsed to allow the work to reach hardening temperature, the torch is shut off and the quenching water is turned on while the work is still spinning. For high production the lighting of the torch, the duration of heating and the timing of the quench are all regulated automatically by cam mechanism. The operator merely placing the work in the machine and pressing the starting button. With such an arrangement absolute uniformity of hardness and depth are obtained provided constant gas pressures are maintained at the tip.

Flame hardening tips can be obtained to fit irregular contours. In many cases, however, it is preferable to split up such a contour as a separate operation. The resulting simplifications in tip design considerably reduces their cost and promotes easy operation.

The hardening of gear teeth offers one of the best examples of the flame hardening principle, since only a limited area on both sides of a tooth at the pitch line must be hardened. It is possible to harden gears with practically no distortion, so that the gear can be previously finish machined in the unhardened state.

In hardening gear teeth, the tooth profile is divided into two parts and heating tips are designed to fit each half of the tooth contour. Spur, sprocket, worm and herringbone gears are hardened by mounting the tips in a yoke at a fixed distance apart and providing for uniform motion of the tips along the tooth. The torch is

lighted and the quenching water turned on before the tip begins to traverse the tooth. When the path is completed the gas is shut off and the tip drawn back, the gear is revolved one tooth, the torch relighted and the cycle repeated. Special equipment is required in the case of worm and herringbone gears to rotate the gears as the tips move in a straight line along the gear axis, and with bevel gears for varying the spacing of the hardening tips and the speed of torch travel to accommodate the varying cross section of the tooth. In hardening worm and herringbone gears use is made of a follower engaging between two teeth and thus fixing the path of the tips which are mounted separately and connected by flexible leads to the flame hardening torch. The gear is turned on its axis as the hardening operation proceeds. Gear hardening machines, incorporating these features have been built and are available for the production hardening of gears.

Test for Hardenability

In spite of the apparent simplicity of the process a few fundamental points should be kept in mind in approaching flame hardening problems. If the exact composition of the part is not known a test-piece should be taken, and heated in a furnace to 1500 deg. F. and quenched in water. Testing with a file or on a hardness testing machine will show whether the steel is hardenable or not. Should the material show no appreciable increase in hardness it is frequently possible to change the material specification usually by increasing the carbon content.

Wherever possible, fine grained steels should be chosen for parts to be flame hardened. Their inherent tendency to resist grain growth being a safeguard against over-heating by an experienced or careless operator. Their shallow hardening characteristics are no disadvantage to the process.

In order to derive complete freedom from distortion forged or cast parts should be normalized in the usual way before flame hardening. If maximum toughness of core is also desired normalizing should be replaced by furnace hardening followed by a tempering operation at 100 to 200 deg. F. below the critical range. This is followed by finish machining and finally flame hardening, giving maximum surface hardness with greatest core toughness and freedom from size change.

A neutral flame setting of the torch is best and this combined with rapid quenching gives work which is as scale free as that coming from a controlled atmosphere hardening furnace. Heat input should be rapid which means that gas pressures should be high and torches and tips as large as possible. Low heat input permits wasteful loss of heat by conduction into the body of the metal resulting in higher gas consumption. Generally it will be found possible to harden 4 sq. in. of surface for each cubic foot of oxygen and acetylene consumed. Ample quenching volume should be used to secure high hardness. Simple trials will determine the correct settings of torch speed, gas flow and rate of quenching to produce any degree of hardness and depth of penetration desired.

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How To Test Strength Of Bronze Welded Cast-Iron

By A. F. MORTON

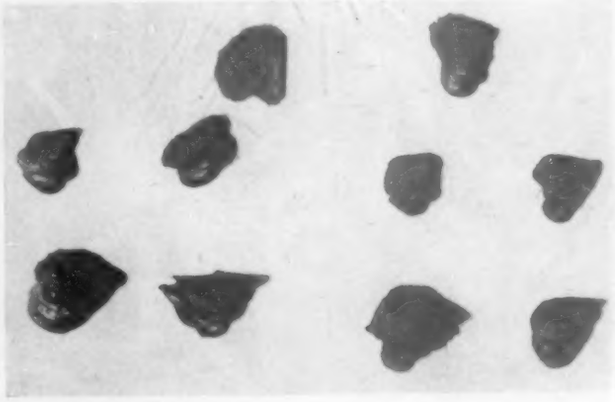
★ With all the photos and articles appearing in trade journals, dealing with the repair of cast-iron with bronze, it is surprising to see how many welders and foremen still have doubts as to the reliability of this method of repair. This article should eliminate any doubts in the minds of skeptics as to the reliability of brazed cast-iron repairs.

We had a large 6 cyl. diesel motor block in our shop which had the side knocked out by a connecting rod which "let go." The usual method of preheating and welding with cast iron was ruled out, owing to the possibility of warping the piece and not being able to handle it in our machine shop. The "boss" declared: "We want strength on this job. We know others are getting, or claim to be getting good results from bronze welding jobs of this size, but I don't think we will take a chance. We will play safe, and buy a new block." But the block was not junked, it was brazed and put back in service.

The accompanying illustration shows a number of pyramids of bronze which had been built up on an old cylinder head, using a bronze rod and a well known flux both designed for brazing cast iron. When we had the piece ready we asked the "boss" to knock them off. He did, but it took more than one good blow to break them off with a machinist's ball peen hammer. And every piece that was knocked off, tore out a deep piece of the cast iron in the area where it had been brazed on. After this test we brazed the diesel block.

While this test is not new, it proved to our "boss" a lot of things about bronze welding. Maybe it will be useful to others. With this test it is possible to try bronze on any casting before doing the job. It pays to test when doubtful because we have found some castings that would not take bronze.

Those who still doubt the value of bronze welding cast iron may lose their skepticism if they try this test. A good torch with a good pair of acetylene and oxygen regulators, and materials made expressly for brazing cast iron are essential.



Test pyramids of bronze which had been brazed to cast-iron and later knocked off with heavy blows from a machinist's hammer.

Top of a nickel-clad steel soap boiling kettle. Fabricated from ¼ in. and 5/16 in. plate (10% clad). Diameter 15 ft., depth 29 ft.

Welding data to help the fabricator

Using Nickel-Clad Steel

★ Part 2—Joints used in tank construction —Oxy-acetylene welding procedure described—How to make "position welds"

By F. P. HUSTON[1] and T. T. WATSON[2]

THE BEVELLED butt joint, Fig. 7, should be used whenever the nature of the work allows. Field erection of large storage tanks may require the lap joint shown in Fig. 9.

Fillet welds are encountered frequently in tank fabrication, and usually two fillet welds are involved, as in Fig. 13B. A continuous nickel surface is maintained by deposition of nickel weld metal, while the second fillet involves joining a steel surface (the back of the nickel-clad steel plate) and a nickel surface. This joint can be made in either of two ways: (a) by chipping off the nickel cladding to expose the steel base below and making the weld between the two steel surfaces using a mild steel electrode; or (b) by joining the nickel-clad surface, without chipping, to the steel plate using a No. 130X Monel electrode. The latter procedure produces a weld having satisfactory strength and ductility and may, in fact, be more economical than chipping and using a steel electrode.

The carbon arc is a useful method of welding the nickel side and can be relied upon to yield strong, dense welds of high ductility. Excellent results have been obtained in welding vertical joints, because of close control over the rate of fusion and the placement of the deposited metal. The steel side should be welded with the metallic arc.

Inco No. 21 nickel welding electrodes, flux coated for carbon arc welding, 3/32 in. or ⅛ in. diameter, are used with carbon rods 3/16 in., ¼ in., or 5/16 in. in diameter. The carbons are ground on an emery wheel to a fine point, tapering back about 2 in. These have low current carrying capacity and reach a white heat quickly. A short grip, 3 to 4 inches long, is taken by the holder to prevent excessive wasting away of the carbon by oxidation, and to improve the comfort of the operator.

Straight polarity, i.e. carbon negative, should be used. If the operator does not know the direction of current flow, the behavior of the carbon will provide a means to determine the proper circuit connection. Reversed polarity will cause the carbon to become blunt and to burn away rapidly. The crater, characteristic of the positive side of the arc, is usually present.

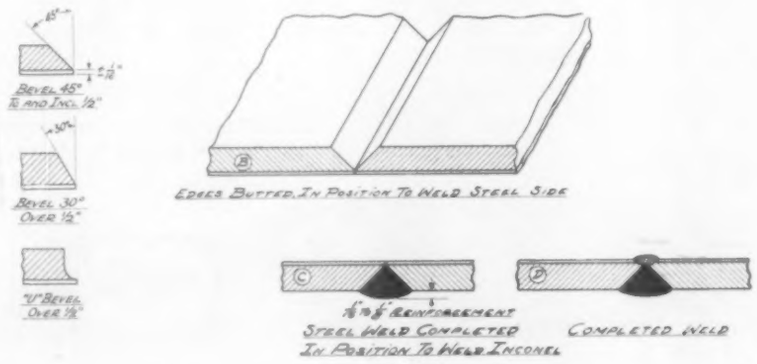


Fig. 7—Joint designs for metallic arc welded butt joint

[1]Development and Research Division—The International Nickel Co., Inc.

[2]Development and Service Metallurgist—Lukens Steel Co.

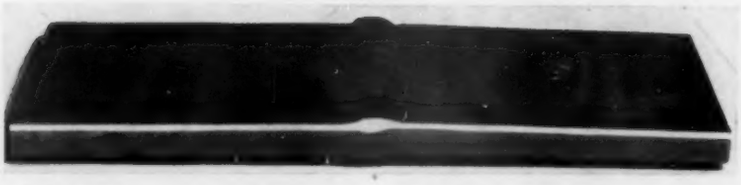


Fig. 8—Cross section of metallic arc welded butt joint in nickel-clad steel plate.

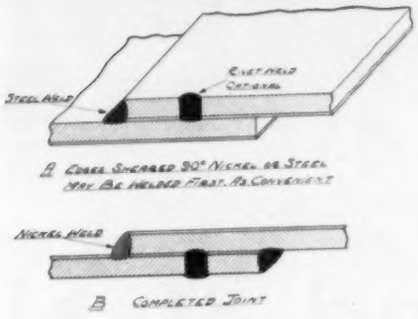

STEEL WELD
FILLET WELD OPTIONAL
A COVER SCRAPED 90° NICKEL OR STEEL MAY BE WELDED FIRST AS CONVENIENT
NICKEL WELD
B COMPLETED JOINT

Fig. 9—Design of lap joint for metallic arc welding.

The arc is "wild" and difficult to control. On the other hand, a properly connected circuit gives a smooth, quiet arc. The carbon retains the pointed end and operates at a much lower temperature.

The current is adjusted to as small a value as possible to give a steady arc and the proper rate of fusion. The welding rod must not be fed into the arc before the plate is heated sufficiently to melt the surface of the joint, and care must be exercised to keep a wetted surface ahead of the advancing pool of weld metal. Excessive amperage must be avoided so as to prevent the formation of troublesome craters at the point where the arc is broken.

Carbon arc welding may be used in welding light gauge linings in outlet fittings, manholes, and other sheet metal in conjunction with plate work.

Oxy-Acetylene Welding

The results of an investigation made in the research laboratories of the Linde Air Products Co. on acetylene welding of nickel-clad steel plate have established gas welding as an alternative method of joining and one well adapted to vertical welding.

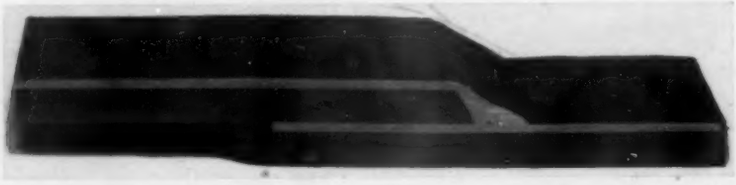


Fig. 10—Cross section of lap welded joint. Either nickel or steel side can be welded first.

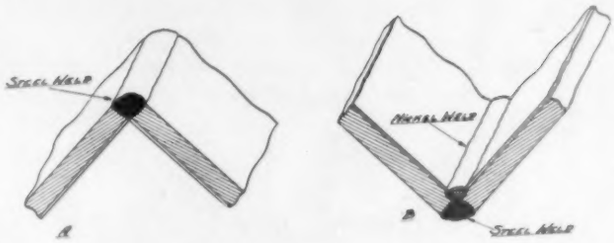


Fig. 12—Procedure in making inside fillet weld at a corner.

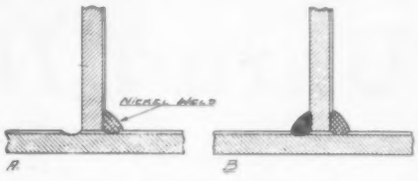


Fig. 13—Double fillet welds at a T connection. At "A" the nickel has been chipped to insure penetration into steel plate when using steel electrode.

The beveled butt joint shown in Fig. 7 is the best type for general use, but other types common to steel plate welding can be expected to give equally good results.

The use of multiple layer welding, to reduce the iron content of the weld metal, as shown in Fig. 14B, is not advisable with acetylene welding. The outside corner joints shown in Figs. 14C and 14D are the best types to use.

Usually the steel weld is made first, then the nickel weld. No change is made in welding the steel side over the accustomed practice in welding solid steel plate. In acetylene welding the nickel side, the all-important rule—"maintain a slightly reducing flame"—must be observed. The sharp, oxidizing flame that yields entirely satisfac-

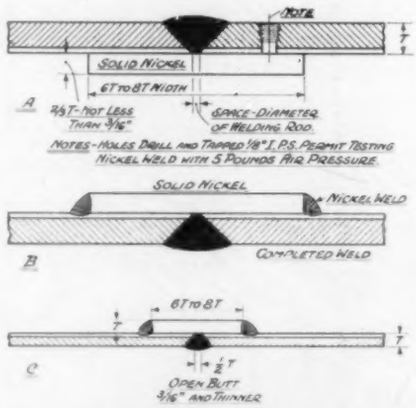


Fig. 11—Types of strap joints to maintain continuity of nickel lining.

tory welds in steel will give brittle and spongy welds in nickel.

Inco No. 41 nickel gas welding wire should be used. This wire is supplied in 36 in. lengths and is used bare. No welding flux should be used with it.

The reducing flame with a given tip size and acetylene pressure is not as intense as the sharp, oxidizing flame, and a tip one size larger than the tip used under steel welding conditions may be required. With the larger tip, both the acetylene and the oxygen pressures should be reduced to give a soft, easy flame.

Position Welding

In the erection of large storage tanks in the field, the tank cannot be put into position to weld all joints "down hand," as is possible in shop assembly. The operator must, therefore, be prepared for vertical, horizontal, and overhead welding. Vertical welding on the nickel side is accomplished readily and results equally as good as in "down hand" welding are obtained. This type of work is done usually by companies organized and experienced in handling the many details of outside erections, and their welders are skilled in this class of work. The welding of nickel may be new to them, but by practice the average good welder will learn quickly the manipulation that yields proper welds.

A greater degree of skill is required in vertical welding with the metallic arc than with the carbon arc or oxy-acetylene methods. The deposition of the metal is effected by the adhesion and surface tension between the glo-

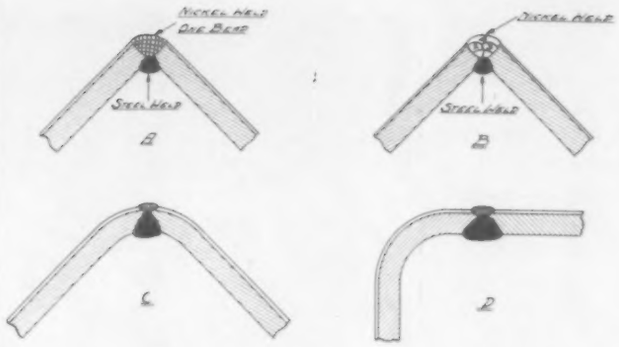


Fig. 14—Outside corner welds. (A) Not advisable on account of iron pick-up. (B) Multiple nickel beads (less iron pick-up). (C) and (D) Preferred methods.

bule of molten metal on end of electrode, and film of molten metal on surface of plate.

Vertical welding may be done either by welding from the bottom upward or from the top downward. In welding from the bottom upward, an almost horizontal face or shelf is formed by weaving the electrode. The electrode is inclined, as shown in Fig. 17, and the fusion at the base of the weld is kept slightly ahead of the outside.

Some operators prefer to weld from the top downward and are able to obtain sound welds more comparable to down-hand welds in appearance, width

Fig. 15—Striking demonstration of permanence of bond in 20% nickel-clad steel.

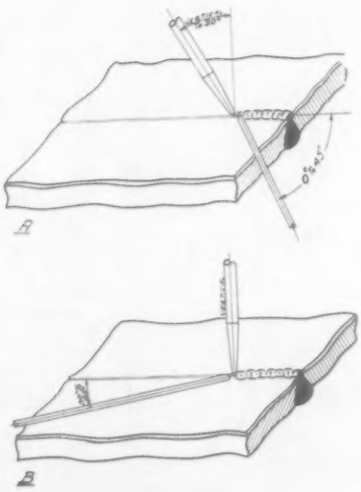


Fig. 16—Two accepted procedures for carbon arc welding of nickel-clad steel.

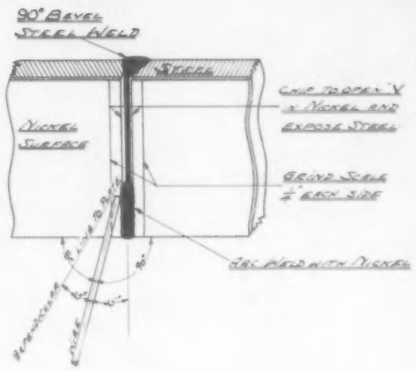


Fig. 17—Procedure for vertical welding with metallic arc.

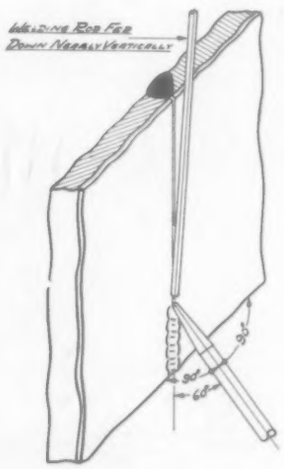


Fig. 18—Recommended procedure for vertical welding with carbon arc.

and height of bead, depth of fusion, and freedom from undercutting.

Horizontal welding with the metallic arc is accomplished by applying the same principles as in vertical welding. The shelf is inclined at an angle of about 45 deg. from the vertical, and the fusion of the lower portion is kept in advance of the upper portion. The position of the electrode is downward and to the side, in a back-hand direction to the advancing weld.

Fig. 18 illustrates the preferred positions of the carbon pencil and the elec-

Fig. 19—Gas welding a vertical seam on the steel side. Photo (Linde Air Products Co.).

trode in vertical welding. Carbon pencils ¼ in. diameter are used with No. 21 flux coated nickel rods 3/32 in. diameter on plates up to 5/16 in. thick. For heavier plate, 5/16 in. carbons with ⅛ in. flux coated nickel rods are used. The current is set by trial to suit the plate thickness and to effect prompt fusion of the base metal, but not so high that deep craters form on breaking the arc. The end of the welding rod is first admitted into the arc stream just after a glossy film of molten metal begins to show on the plate and the face of the weld. The small diameter weld rod melts quickly, and the metal is deposited smoothly and evenly.

The welding of vertical and horizontal joints with the acetylene torch is almost as simple as "down hand" welding. The selection of the tip size, gas pressures, and welding rod in acetylene welding follow closely those given for "down hand" welding with the exception that a smaller bare nickel rod should be used.

Peening or bobbing to compact the

Fig. 20—Gas welding a vertical seam on the nickel side. Photo (Linde Air Products Co.).

nickel weld metal is not necessary, though on very particular work peening may be done. The weld is improved in density, physical strength, and corrosion resistance. Pneumatic chipping hammers are used with flat-faced tools slightly rounded at all corners. The tool is held squarely against the weld and moved back and forth laterally and across the weld, with a rocking motion to conform to the curvature of the weld. Sharp cornered tools that may cut into the nickel along the line of the weld must be avoided.

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Recommended Welding Procedure For High-Carbon Steels

By E. W. P. SMITH*

WHEN A BEAD of weld metal is run on a cold steel plate, the temperature of the parent metal is raised. The temperature increase will vary, ranging from the melting point at the fusion zone down to perhaps no increase at all some distance from the bead. Due to the fact that the cold metal conducts the heat away very rapidly, the cooling rate of the parent metal, adjacent to the weld, is approximately the same as if the plate was quenched in water.

This fact, which is not generally appreciated, is an important one to consider in connection with the welding of high-carbon steel. For it is the zone adjacent to the weld in which cracks occur in high-carbon steel.

The thickness of the zone, (when welding on cold plate), will depend upon the heat input and thickness, or mass of metal on which the bead is deposited. The thickness of the zone, when the welding is done with 3/16-in. electrode and the rate of arc travel is normal, may be ⅛-in. thick on 2-in. plate and ½-in. thick on ¼-in. plate.

Contrary to general belief, the cracking which occurs in welding higher carbon steels is not due to a weakening of the parent metal. Rather is it due to the hardening effect produced by high rate of cooling. The hardening reduces ductility to the point where the metal cannot stretch; it therefore cracks. The cracking is analogous to what we call "quenching cracks" which are frequently encountered in heat treating high-carbon steel.

In steels containing up to .15% or .20% carbon, quenching in water from above the critical temperature causes very little hardening. On the other hand, 1.00% carbon steel, quenched in water from above the critical temperature, will have a hardness of 700 Brinell. Such material has practically no ductility.

The hardening effect of quenching steel from above the critical temperature, (approximately 1600 deg. F. for .10% carbon and approximately 1400 deg. F. for 1.00% carbon steel), increases as the carbon content increases, assuming that the rate of cooling is constant.

In addition to the carbon content, there is a second factor which affects hardening. This is the rate of cooling. For a given carbon content, the hardness of the steel will increase as the rate of cooling increases. As a specific example, .85% carbon steel, heated to 1450 deg. F., and cooled very slowly, will result in an annealed structure having a hardness of approximately 250 Brinell. Cooling from 1450 deg. F. in still air, will produce a hardness of approximately 300 Brinell. If the quenching is in oil, hardness will be approximately 300 Brinell; if in water, approximately 600 Brinell. Quenching in iced brine will produce still greater hardness.

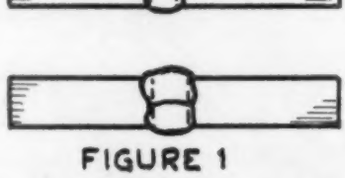

FIGURE 1

Fig. 1—Scarfing the joint in welding steels above .25% carbon minimizes admixture of base metal to the weld deposit and provides maximum ductility.

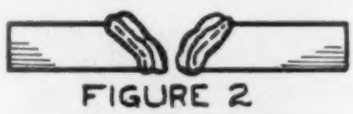

FIGURE 2

Fig. 2—Intermediate beads, in steels over .25% carbon, dilute the carbon and permit welding with low carbon electrode.

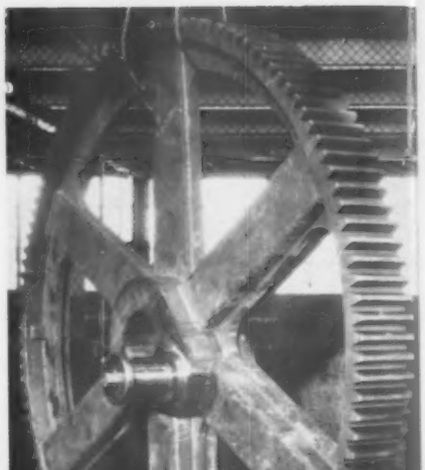

Fig. 3—Welded gear with high carbon rim and mild steel ribs and hub. A small bead is first run. This preheats rim and then final beads are run. Work should be done without interruption, keeping rim heated during entire time of welding. Photo (Lincoln Electric Co.).

Function of Preheating

From the above, it follows that the problem in welding high-carbon steel is one of eliminating the zone of hardened metal which is produced by the heat of welding and the subsequent cooling from above the critical temperature. So far, the only practical method of eliminating the zone of hardened metal encountered in welding high-carbon steel seems to be by preheating the parent metal.

The effect of preheating on hardening has been studied in connection with the welding of battered rail ends in which the carbon content is approximately .80%. When no preheating is employed, a bead of weld metal deposited on a cold rail will produce a hardening of the parent metal just underneath the deposit. The hardness of the metal will be approximately 600 Brinell, regardless of the type of electrode used or the hardness of the metal deposited, compared with a hardness

*Consulting Engineer, Lincoln Electric Co., Cleveland, Ohio.

of approximately 250 Brinell in the original rail. However, note the effect of preheating on hardness. If the rail end is heated up to 400 deg. F. and then welded, the hardness of the zone will be approximately 325 Brinell. The difference in hardness, with and without preheating is due merely to the difference in rate of cooling from the critical temperature.

It is interesting, at this point, to note the effect of hardening on the tensile strength and ductility of the metal. The non-preheated metal, with 600 Brinell hardness, will have a tensile strength in excess of 300,000 psi. and practically no ductility. On the other hand, the 325 Brinell material will have a tensile strength of approximately 150,000 psi., and a ductility of 10% to 15% elongation in 2 in. This ductility is entirely sufficient to enable the metal to stretch without cracking. The value of preheating is, therefore, apparent.

When parts of high-carbon steel are being welded together and are firmly restrained, it is evident that a high rate of cooling and the resulting low ductility will produce cracks. This does not mean, however, that high-carbon steel cannot be welded without cracking under such circumstances.

To prevent cracking of restrained parts of high-carbon steel during or after welding, it is necessary simply to provide some means of permitting the work to absorb the distortion or contraction. Since this absorption cannot take place in the parent parts, it must occur in the weld deposit. The method is, therefore, to use a weld metal to join the parts which is ductile enough to absorb the distortion or contraction.

The method of welding takes into account four important factors: Control of the heating and cooling conditions; proper procedure; use of intermittent beads; and use of different or special electrodes.

Control of the heating and cooling conditions includes preheating the parts to 500 deg. F. or higher, welding while hot and cooling very slowly, as for example, overnight in a furnace. The rate of cooling depends upon the carbon content: the higher the carbon, the slower the rate of cooling. For steels of .30% carbon, proceed as for ordinary steel. Steels up to .40% carbon should be allowed two or three hours to cool, if practical for the work at hand. All night cooling is recommended for .40% or higher carbon steels.

Ductility of Welded Joint

The effects of stresses caused by contraction as the metal cools will be mitigated if sufficient metal is deposited in one pass. If the cross section of the first bead is too small, the unit stress will be high and fracture may occur when the deposit contracts on cooling. This condition is most apt to occur in fillet and lap joints.

Proper procedure involves selection of the type of joint, particularly in steels, .25% or higher in carbon. The importance of the joint selection is due to the effect of the admixture of base metal into the weld deposit. The joint should be such that a ductile bead is obtained to avoid failure which may occur particularly if the parts being welded are fixed.

In case the parts are fixed, it is advisable to scarf the edges of the parts, (See Fig. 1), rather than use a plain butt joint. This minimizes admixture of base metal with the weld deposit and assures maximum ductility.

Use of intermediate beads is frequently employed in welding steels higher than .25% in carbon. An example is shown in Fig. 2, which illustrates a single vee butt joint. The joint is made by applying one or two layers of heavily coated mild steel electrode to the scarfed edges. These beads dilute the carbon, providing surfaces which are relatively low in carbon thus permitting welding with low carbon electrode as in ordinary procedure. Obviously, this type of joint is not high in carbon, which fact should be remembered in any consideration of its use.

Use of different, or special electrodes in welding higher carbon steels should receive consideration. An electrode for welding 18% nickel, 8% chrome steel provides an excellent joint in steels above 30% carbon. The metal does not penetrate greatly, yet the fusion is excellent. A high-carbon electrode may be used where the heating conditions can be controlled. This control can be exercised to some extent by the length of the arc.

Conclusion

From the foregoing, it is evident that the best procedure for the welding of the higher carbon steels is to heat above 500 deg. F., weld while hot and cool slowly when the carbon content is well above .30% and employ intermediate beads and/or special electrodes in welding the steels near .30% carbon.

If the carbon or alloy content in the base metal is too high, brittleness will occur, regardless of the type electrode used. The only way to control brittleness in the base metal within the welded zone is by controlling the heat (cooling rate) and the chemical composition. The only effect of the electrode composition is in controlling the properties of the weld deposit.

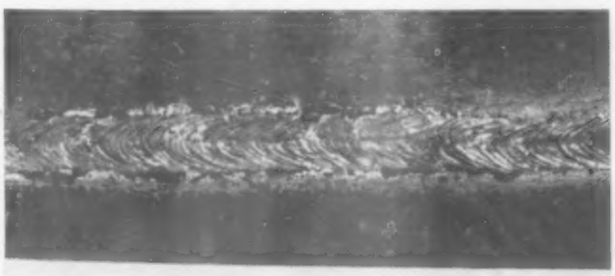

Fig. 4—Plates were preheated and the joint was welded hot.

Fig. 5—A crack in a high carbon welding bead. This joint was welded cold.

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STEEL FURNACES EXPAND CAPACITY—The total manufacturing capacity of the furnaces producing steel in the United States has expanded approximately 1,030% since 1889, although the number of such furnaces has increased only 350% during this 50-year period, according to the American Iron and Steel Institute.

Welding steel "T" pan roof on Link-Belt Co. building addition to Chicago plant—Photo (General Electric Co.).

Final section of series of practical articles on

Technique of Arc Welding

★ How to make overhead butt welds—Several methods of repairing cast iron—Suggestions for welding stainless steel and aluminum

By ROY OWENS
Welding Instructor, Electro-Motive Corp., La Grange, Ill.

FIGURE 52 SHOWS a two-pass butt weld made overhead. The first pass *A* is put in by using an oscillating motion, or a stringer weld may be used. The oscillating motion will fill the vee so that the second pass *B* will not require as large a filling as it would if a stringer weld was used. The electrode is held at 10 deg. ahead of the weld. The stroke from *1* to *2* is carried back over some of the previously deposited filler metal to increase the build-up. From *2* to *3* the stroke is carried ahead of all previous strokes and into the smaller part of the vee with a short arc to insure good fusion and penetration.

A ⅛ in. electrode will give best results for first pass with 100 to 125 amp. and 70 to 80 volts (open circuit). A larger electrode can be used, but results will not be the same, as the chances of non-fusion in bottom of vee are too great. After first pass is finished, all scale should be completely removed before starting second pass. The electrode size for second pass should be increased to 5/32 or 3/16 in. depending on amount of filler to be added.

Motion *B* is a cross stroke from side to side with a slight advancement forward on each stroke. The electrode is held at same angle as previous weld. The operator may encounter trouble with the weld sagging along center line and with improperly filled edges. This is generally caused from traveling too slowly across the weld, causing it to become overheated, flow to center, and sag. To overcome this fault, the arc should be carried across center portion of weld quickly with a slight hesitation at the end of the stroke, so that center of weld will be kept at about the same temperature as the edges. If insufficient heat is used on welds of this type, the weld will have a very deep ripple, making it necessary for the operator to travel slower and depositing more filler metal on each stroke. If proper heat is used the deposit will be thinner on each stroke, but the strokes will be more frequent. As a result the bead will have a smaller ripple and neater appearance.

Figure 53 shows a butt weld made overhead using stringer beads. First pass is put in with ⅛ in. electrode by holding a close arc and drawing the arc

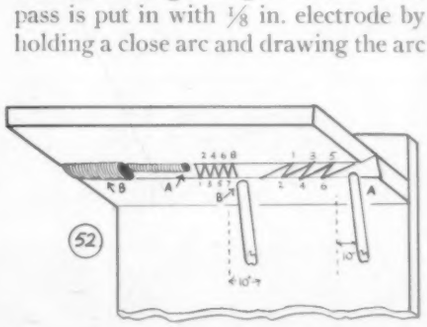

Fig. 52—Procedure for two-pass butt weld made overhead.

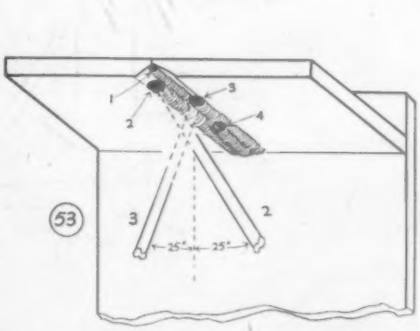

Fig. 53—Overhead butt weld using multiple stringer beads.

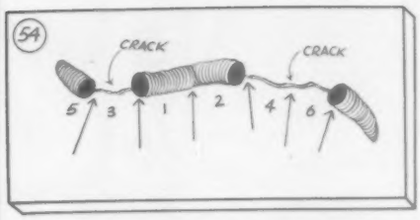

Fig. 54—Repairing a cracked motor block (cast-iron) without preheating.

straight along the vee. For second pass a 5/32 or 3/16 in. electrode should be used, carried at a 25 deg. angle from the vertical plane so that the arc is concentrated on one side of the vee. Also, for third pass the electrode is slanted 25 deg. from vertical plane, but in the opposite direction. When third pass is finished the weld metal should fill in along the sides to the desired height but with a low center. Then the fourth pass is put in with the electrode in a vertical position, except for a 10 deg. slant ahead of weld, and filling up the low place left between the second and third pass.

Repair of Cast Iron

Figure 54 shows a method that is frequently used on light sections of cast iron, such as cracked motor blocks and heads, and where no preheating is done. The weld is only good for a water-tight job and can withstand very little pressure. Preparing the job before welding is important. All oil, grease and rust should be removed as these foreign substances will cause blow holes in the weld. When the job is ready for welding, the operator should trace the crack to the end and mark it; then strike an arc ½ in. beyond the mark and hold a long arc for for an instant to allow parent metal to be heated. Then the arc gap should be shortened to proper length and a weld made over the end of crack to check it from extending during the process of welding remainder of crack. This should be done at both ends of crack.

Weld No. *1* is then started at center of crack and run to the left approximately 1 in. as indicated. This weld is allowed to cool to the stage where the operator is able to hold his bare hand on the weld. Then weld No. *2* is made by going in opposite direction, approximately 1 in. The weld is completed by alternating beads as numbered on sketch. The reason for alternating beads is to keep the heat spread uniformly over the entire surface. If the casting is heated to an extreme temperature at one spot trouble may be encountered with the weld cracking along line of fusion due to contraction when cooling.

The electrode used is an alloy designed for welding cast iron only and has a low melting point (approximately 2000 deg. F.) which is about 300 deg. under that of cast iron. All electrodes are not suited for welding of cast iron due to their high melting point.

Figure 55A shows a weld made on a heavy section of cast iron using stud bolts. On this type of weld the base metal is veed out and holes are drilled along the edge of the vee in staggered formation. These holes are then tapped and stud bolts are put in and drawn up tight. A bead is run around each stud and then a lacing bead is put in, tying the studs together. The final weld is put in on top of the previous welds. Stud bolts are used to prevent the weld from peeling. The studs supply a better bonding than fusion to cast iron. These welds are used where it is necessary to withstand a certain amount of pressure, or on the inside of cast iron boilers where the metal has been subjected to the open fire and is more difficult to fuse.

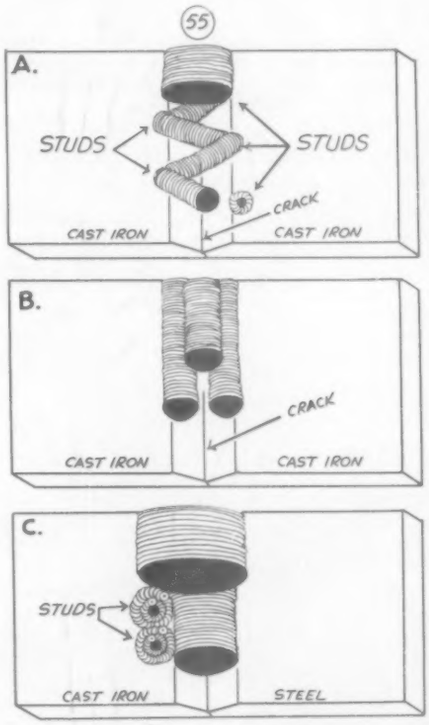

Fig. 55A—Welding heavy cast-iron sections with aid of steel stud bolts. Can withstand reasonable pressure.

Fig. 55B—Improved ductility of cast-iron weld obtained by using three stringer beads.

Fig. 55C—Use of studding to arc weld steel to cast-iron.

Figure 55B is a three-pass weld made on cast iron and is used to some extent on sectional boilers where the iron may be of poor quality. The theory is that by putting in a bead on each side of crack twice as much fusion surface is obtained on each side of crack than if a single bead is put in covering the break. The third pass is put in by lapping over almost half of the two previous welds. This last bead will not collect much carbon because it is deposited on the added filler metal. It will have enough ductility and elongation to take care of any contraction during cooling.

Figure 55C is a method used to arc weld steel and cast iron together. The cast iron is studded 1½ in. apart and two beads are run around each stud. Then a good cleaning should be done before making the first pass. After first weld is put in the operator should repeat the cleaning job and allow the weld to cool. Second pass is put in extending out on cast iron enough to cover the studs completely and to obtain as much fusion surface as possible. The steel studs represent about 50% of the bonding on the cast iron, since steel has a tensile strength about four times that of cast iron.

Stainless Steel

Before concluding this series of articles I want to add a few words about welding of stainless steel and of aluminum. Stainless steel has a low heat radiating capacity which means that low welding current should be used for best results and also a short arc. If a long arc is carried there will be excessive spatter. A long arc may cause a change in the analysis of the metal in the weld and heat-affected zone. Some of the alloying elements may be melted out causing the weld zone to become subject to rust or corrosion. If proper heats are used, the filler metal will flow out to a smooth bead with good penetration and fusion.

Aluminum will be found different from other metals in welding. The average operator will travel too slowly and burn through. Aluminum at the melting point retains its natural color which is confusing to the beginner. For best results when working on aluminum, a low voltage should be used, not over 75 on open circuit, and a higher amperage than used on steel, for the same size of rod. The reason

for high amperage is that aluminum will conduct heat away from the weld almost as rapidly as copper. The arc length should be carried very short with the coating almost dragging on the metal. Sheet aluminum may be welded better and more easily with a straight bead eliminating all side motion. On cast aluminum some jobs may give the same trouble with expansion and contraction as encountered with cast iron and may require pre-heating. Aluminum will fuse more readily if preheated.

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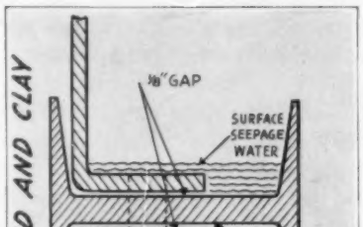
Welding and Cutting Helps Chicago Get Started on its Subway

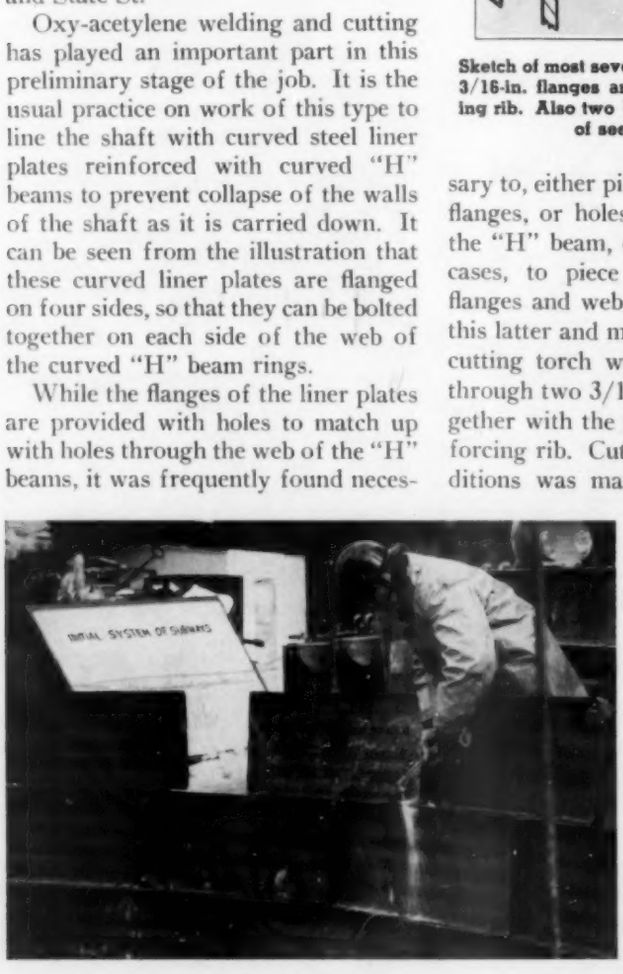
★ After many years of political ballyhoo regarding a subway for the City of Chicago, actual construction work was started in December, 1938, amidst a fanfare of newspaper publicity. Contract was awarded to the Herlihy Mid-Continent Co. to start construction on the initial system of subways. An entrance shaft 26 ft. in diameter has been sunk in the rear of the property located at 21 West Chicago Ave., approximately 300 ft. south and west of the intersection of Chicago Ave. and State St.

Oxy-acetylene welding and cutting has played an important part in this preliminary stage of the job. It is the usual practice on work of this type to line the shaft with curved steel liner plates reinforced with curved "H" beams to prevent collapse of the walls of the shaft as it is carried down. It can be seen from the illustration that these curved liner plates are flanged on four sides, so that they can be bolted together on each side of the web of the curved "H" beam rings.

While the flanges of the liner plates are provided with holes to match up with holes through the web of the "H" beams, it was frequently found necessary to, either pierce holes through the flanges, or holes through the web of the "H" beam, or in the most severe cases, to piece holes through both flanges and web in one operation. In this latter and most severe condition a cutting torch was required to pierce through two 3/16 in. plate flanges, together with the web of the 4 in. reinforcing rib. Cutting under these conditions was made more difficult because of approximately two ⅛ in. gaps, which existed between the three sections of metal, together with an appreciable quantity of water seeping from the walls.



Sketch of most severe cutting condition. Two 3/16-in. flanges and web of 4 in. reinforcing rib. Also two ⅛-in. air gaps and plenty of seepage water.



Operator is piercing bolt holes through flanges of steel liner plates with oxy-acetylene cutting torch.

Oxygen and acetylene cylinders were manifolded with Rego cylinder manifolds and two-stage RegOlators.

After the shaft was carried down to the desired depth (about 48 ft.) the contractor faced the problem of reinforcing the shaft walls by means of two vertical 16 in. "I" beam columns, 18 ft. in height, used as supports for horizontal members placed at the bottom and top of the entrance of the tunnel, which had to be driven eastward to State St.

The illustration on the front cover of this issue shows the operator welding the flanges of a 16 in. column to the horizontal reinforcing beams. This welded connection was effected by first bolting an angle iron section to the flange of the 16 in. column, and then making vertical fillet welds to the inside flanges of the reinforcing columns. The operator also made horizontal welds by tying the back of the angle iron to the face of the 4 in. reinforcing flange. When this part of the welding was completed, the two horizontal "I" beams were then cut to fit the flanges of the columns and then welded in position. This construction effectively braced the entrance shaft so that the contractor could cut out the plates for the tunnel construction. This, in the language of the tunnelling profession, is known as the critical act of "turning the eye."

For all cutting operations the contractor used a Rego full-range cutting torch. Contractor employed Rego Type GX Universal welding torches with GX-32 tip assembly and 3/16 in. RegOroD No. 13, high-tensile welding rod in accomplishing the structural

(Continued on page 37)

Brief Sketches of Welding Jobs

A welded steel floor of "cellular" type, shop fabricated in sections 2 ft. wide, was tack welded to the floor girders in construction of Ellis Hospital addition in Schenectady, N. Y.

Ellis Hospital Addition Built by Welding

★ Steel framework for a four-story addition to Ellis hospital, Schenectady, N. Y., has recently been completed. Welded construction was employed because of its inherent quietness. It was essential that construction noises be held to the absolute minimum. This hospital addition is the seventh building with an all-welded steel frame to be erected in the city.

During the erection of the steel framework, as fast as operators welded the various structural members in place, workmen from H. H. Robertson Co., Pittsburgh, Pa., laid a welded steel floor. This flooring, known as Type K Robertson Cellular Steel, was formed in the shop and shipped in two-foot-wide units to the building site. Thus, the actual laying of the floor became a relatively simple matter. Workmen placed the sections together according to plan and welding operators, using General Electric motor-generator arc-welding equipment and electrodes, tack-welded the sections to the floor girders. Wire mesh was then laid on top of the assembled sections and concrete was poured over the mesh forming a rigid, fireproof floor. The hollow steel floor beams, embedded in concrete, afford an excellent means of carrying electric wiring for both present and future requirements.

In this case, the welding method proved a particularly desirable means of construction because of its quietness on a job where the minimum of noise was absolutely essential. Sound measurements taken in a patient's room during the construction showed that, with the windows closed, the prevailing noise level in the hospital was less than that created by normal conversation as a result of the use of electric welding.

» «

Welder Checkmates Malicious Tampering

★ Malicious tampering with oil well connections frequently causes serious loss of crude production, while even more widespread is the stealing of gate wheels and other easily detachable equipment by sneak-thieves and scrap metal dealers. This often holds up the scheduled flowing of wells and may necessitate a long trip back to the warehouse for a spare wheel with which to manipulate the gate valves at the well head.

Welded buckets chained to the well head prevent unauthorized tampering with valves.

The welder for one oil company got around the thieves and effectively enclosed the gate wheels by welding up "buckets" from short sections of pipe large enough to enclose the entire exposed valve stem with the wheel in place, sealing the bottom of the bucket with a disc cut from tank plate, and welding a "bail" of high-carbon steel chain at the other end, one link forming a hasp for the padlock and permitting the cover to be pulled tightly around the valve before locking.

In the picture a valve wheel is shown atop the well-head connections, this being where the wheel is usually fastened with chain when the usual types of stem locking devices are used for preventing unauthorized flowing of the wells. With the "buckets" the shifting of wheels is eliminated and they may be fastened snugly to their stems, and are always in place when wanted.

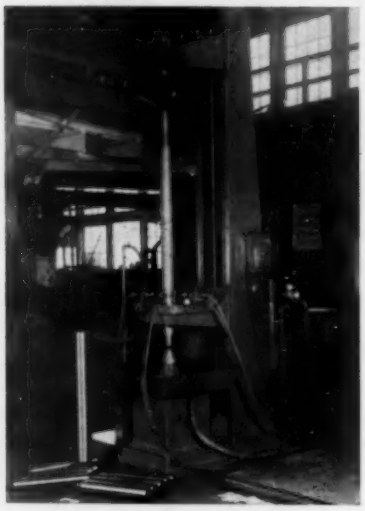
» «

Flame Hardening Shafts and Plungers of Gould Pumps

★ The process of flame hardening is not new, the principle being known almost as far back as the first application of oxy-acetylene welding to steel. However, the application of the process to production work is of recent date. Since the development of a workable water cooled tip, the process had come into prominence in the metal-working industries. The desire to furnish customers with better pumps led Gould Pumps, Inc., to investigate the possibility of applying flame hardening to certain pump parts.

This flame hardening machine will harden work up to 8 in. in diameter by 96 in. long. It is of all-steel welded construction and consists, primarily, of a revolving center to rotate the work, a torch carriage to hold the flame hardening torches and the quenching jets, and a column to guide the torch carriage. Change gears provide the means of maintaining proper surface speed. A separate water supply with a circulating pump maintains constant pressure for cooling and quenching jets. One motor drives the center and water pump, while a reversible motor drives the torch carriage raising screw.

The machine is used to harden shafts and plungers of steel or cast iron. To date the new method seems better than the carburization method formerly used. The carburizing



All welded flame hardening machine built by Gould Pumps Inc. for selective hardening of shafts and plungers.

took about six hours and very often the work was warped. Time is cut with the flame hardening machine, penetration is greater, and warping does not occur. As a result, Goulds can now furnish plungers for triplex pumps that will give much more service than before and also furnish certain shafts for centrifugal pumps with the part that comes in contact with the stuffing box packing flame hardened to 90 Scleroscope.

Extensive tests show a very uniform close grained hard outer shell is formed for a depth of ⅛ in. It is possible to get from 90 to 100 Scleroscope on .50 point carbon steel and from 555 to 600 Brinell on cast iron.

» «

Welded Steel "Marsh Buggy"

★ Here is something new in the "marsh buggy" line! Instead of pneumatic tires, the newest "marsh buggy" is built of arc welded steel throughout, even the tires, which are large arc welded steel drums. They are buoyant because of their leakproof arc welded construction.

On water, marsh, or highway, the "marsh buggy" as pictured here, is capable of carrying a 6,000 lb. load. This is possible because the arc welded unit is so constructed that it will float on water and operate on land.

The complete "buggy" weighs 10,000 lbs. and measures 21 ft. in length and 15 ft. in width overall. The wheels which are 7 ft. in diameter and 4 ft. wide, are of an air tight construction. The entire machine was welded with Lincoln "Fleetweld" electrodes.

The unit is powered by a Lincoln-Zephyr engine which gives an operating speed of 2 miles per hour in water, 7 miles per hour in marsh and 12 miles per hour on the highway. This "marsh buggy" was constructed by The Stanolind Oil and Gas Co., Dallas, Texas, for transportation and exploration work in marshy sections.

» «

Welded Ladles for Steel Plant Show Weight Saving

★ The first 120-ton welded ladle for Bethlehem Steel Co. was placed in service about five years ago. At present 15 such ladles are in use at various Bethlehem plants. The ladles shown in the illustration are two of a series of nine recently completed.

Improvements in open-hearth practice made it necessary to increase the capacity of ladles. The lifting capacity of hooks and crane equipment was limited and it was found that it conventional designs were used, the weight of the ladle, including the stopper rigging, would be increased from 54,000 to 65,000 lbs. This increase in weight of the ladle, plus an additional 20 tons of hot metal, would have necessitated expensive changes in lifting equipment and building structure.

However, by substitution of an all-welded steel ladle weighing 38,000 lbs., it was found that no change was necessary in hooks or cranes, and the substitution of 120-ton ladles could thus be made gradually as the smaller ladles became unfit for service.

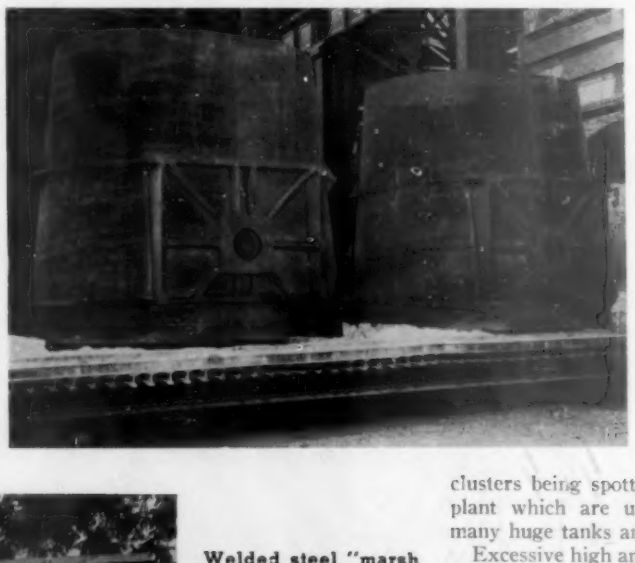
The ladles are welded by qualified welders, from high quality steel plate and forged steel trunnions; they are completely stress relieved after welding. The principal dimensions are: Major axis, top 12 ft. 6 in., bottom 10 ft. 5 in.; minor axis, top 10 ft. 7 in., bottom 8 ft. 6 in.; outside to outside trunnions, 13 ft. 9 in.; height 11 ft. 4 in.

» «

Welding Generators Grouped To Gain More Floor Space

★ Locating 22 welding generators in the most advantageous position for use throughout their plant, was the job of Black, Sivalls & Bryson, Inc., Oklahoma City, Okla., manufacturers of tanks, separators, walkways and welded vessels. They have placed their 22 P&H-Hansen Smootharc welding generators in "clusters" of five, three, etc., these clusters being spotted in those parts of the plant which are used for assembling the many huge tanks and pressure vessels.

Grouping welding generators as shown effects saving of shop floor space.



Two all-welded steel ladles emerging from stress relieving furnace. A substantial weight saving was accomplished by welded design.

Excessive high amperage and voltages are never used to get speedy production, because the very nature of the product demands greater stress on quality than on speed. Both the x-ray and physical testing equipment are used extensively, and all products of this plant are continually subjected to non-destructive as well as destructive tests to maintain a high standard of quality. The photograph shows one of the "clusters" of welding generators serving several booths at one end of the plant. This type of location also aids in spotting power lines, servicing welders, and keeping floors clear.

Welded steel "marsh buggy" designed for oil company geophysical exploration work.

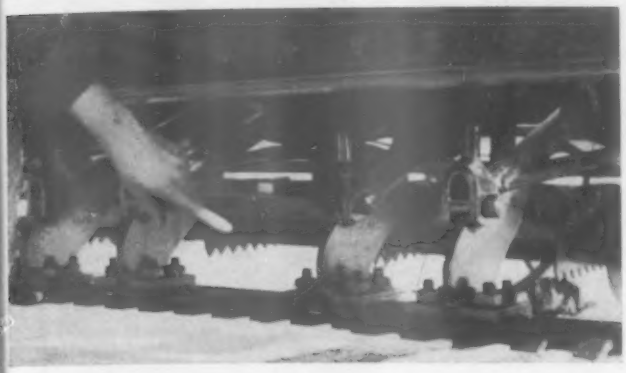


Fig. 2—Cutting feet of surface grader operate like knives on mowing machine.

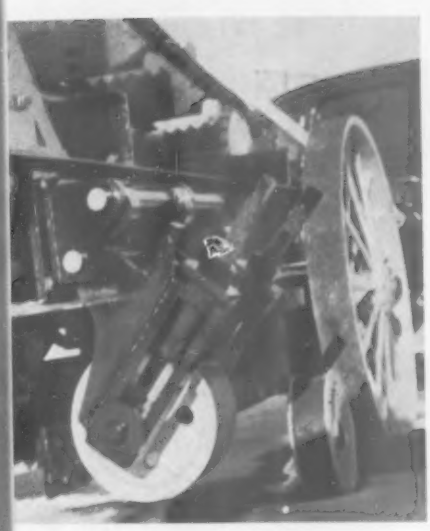


Fig. 1—Adjustable legs on which wheels of road grading machine are mounted.

Long Cutting Knives Used On Welded Road Grader

By IRA B. YATES

★ Emulating the manufacturers of road-building machinery, who have almost universally adopted oxy-acetylene cutting and arc welding for the fabrication of all important structural parts, a welder in the employ of a contractor has built a new type of fine grading machine entirely of cut and welded steel parts. This machine precedes a cement laying machine in the construction of concrete roads.

After the steam shovels have rough graded and the side forms for the cement are down, the finish grader travels along over the ground to be graded, using the side forms as rails on which to travel. Large wheels are provided for moving the machine from job to job, the machine traveling along the forms on the smaller wheels. Figure 1 shows the adjustable legs on which the wheels of the machine are mounted. Note the completely flame-cut and welded construction, even to the tire of the wheel.

The cutting feet, which move like the knives on a mowing machine cutter bar are shown in Fig. 2. These were flame cut from solid plate to shape, scarfed and hard faced.

The machine does not spread and level sand, but prepares the ground for laying concrete. The side forms for the cement road are placed in the tracks on each side of the area to be laid, the ground between the forms not having been excavated. As the machine trails along the forms, the knives work from right to left, cutting off the earth to be removed and passing it back to a conveyor to be discharged at one side of the road. A tractor engine and transmission are mounted on top of the machine for propelling it and operating the cutting arms.

* Wilson Welder & Metals Co., Inc., New York City.

» «

Welded Submarine Pipeline Will Supply Gas to Treasure Island

★ A submarine pipeline—a 4½-in. main 11,000 ft. long—has been strung across the floor of San Francisco Bay, running from Oakland, Calif., to Treasure Island. The line, installed and connected in a novel and spactacular manner, will serve California World's Fair exhibits and concessions with gas for heating and lighting during 1939. Pacific Gas and Electric Co. owns the line; the Pacific Bridge Co. contracted the pipe laying.

Sunk to an average depth of 50 ft., the pipeline has been pre-tested with compressed air at 100 psi. The line was strung from Treasure Island eastward and from Oakland westward, connecting in midbay.

Forty-foot lengths of the pipe were welded into 1000 ft. sections then pulled by a tug-barge out into the bay; as each 1,000 ft. length was pulled out, a newly welded section was connected with it until the entire bay span was completed.

Each section of pipe was floated by air-tight steel drums spaced every 40 ft. along the route. After the Oakland line, which extended 2,000 ft. out into the bay, and the Treasure Island tubing which reached 9,000 ft. out were welded, the drums were cut free, allowing the line to sink to the bay floor. With the main line installation complete, the utility company began laying more than five miles of welded pipe which will serve the various sections of the island with gas during the exposition.

Welding 4½ in. gas pipeline for supplying service to Treasure Island.

» «

Transmission Case Is Bronze Welded

By A. F. MORTON

★ Figure 1 shows a truck hoist transmission case repaired by bronze welding. The stud bolt holes were chipped out, so that when the case was re-drilled and tapped the tools would not go into cast iron. In other words, enough cast iron was removed from the vicinity of the holes to insure that drilling and tapping would be in the bronze.

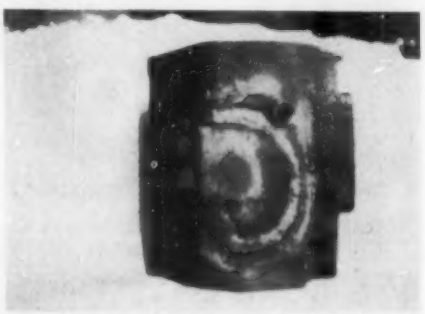


Fig. 1—Bronze welded repair to a truck hoist transmission case.

The broken piece was clamped into its original position. Heavy tack welds in a half dozen places, were made with bronze and then the clamp was removed. Next, the job was surface blasted with steel grit (inside and out), then brazed (inside and out) with a No. 4 tip. No pre-heating was used. The job was file finished, drilled, and tapped, and sent back for assembly within four hours.

The welded case was oil tight, and the machinist had no complaint to offer. No hard spots were created and no warping was in evidence.

Brief Sketches of Welding Jobs

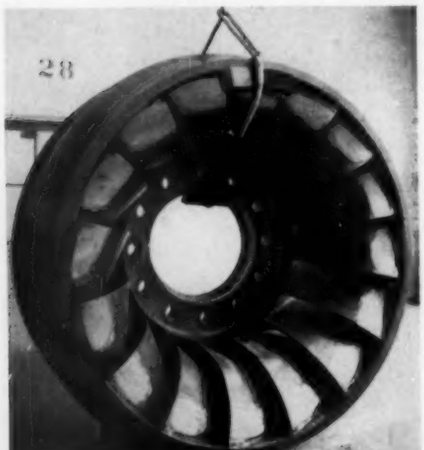
Cast-Iron Runners Repaired For Hydro-Electric Plant

By GALEN F. BIERY

★ The City of Seattle (City Light Dept.) experienced trouble with the cast-iron runners in its hydro-electric generators, due to the action of water and entrapped air causing erosion of the back sides of the blades. It was the common practice to repair this condition by chipping away the affected parts, then drilling, tapping and inserting studs. Then the eroded area was built up by using a soft steel electrode suitable for cast-iron and finishing with a layer of stainless steel.

This practice led to certain undesirable results. Too much time was required preparing the parts. The steel deposit was very hard and brittle. This caused minute checks in the metal and as the welding proceeded, these developed into fair sized cracks in the cast-iron blades.

The hydro runner pictured here was repaired in a different manner. The affected parts were sharply lined and chipped down about 3/16 in., wherever the affected areas were not eaten away to a greater depth. In



Cast-iron hydro runner rebuilt with "Copper Arc" electrode.

this case many of the blades were eaten completely through and some had irregular cavities of various depths. At this stage we started depositing filler metal, using a commercial electrode known as "Copper Arc," which has a copper center and a steel sheet outside.

This is the best binder we have found for cast iron. The deposit is soft enough to be peened, which was done frequently as the work progressed. In peening the metal was worked down to shape of the blades.

This intermediate deposit received the finish coat of stainless steel very nicely. The stainless steel was deposited with a 3/16 in. rod, by depositing about 9 in. of rod on each blade in rotation, peening and cleaning each deposit until completed. When ground this job presented a smooth surface and was free from stresses and checks.

The Copper Arc weld metal acts as a cushion between the cast iron and the stainless steel. We believe it makes a cheaper and better repair job.

Truck-Mounted Portable Welder

★ It doesn't take a large investment to go after welding jobs. E. Cook of Clovis, Calif., mounted a P&H-Hansen welding generator on the back of his Dodge truck and rigged up a power take-off from the truck engine to deliver steady, dependable welding current. He uses this equipment to advantage in the repair, maintenance and fabrication work in his area. Note the large searchlight on the rear of the truck, which Mr. Cook uses on hurry-up night service work.

Mr. Cook on the job with his welding truck.

» «

Cast-Iron Die Repair Used 900 Lbs. of Welding Rod

By STANLEY ROSS, JR.

★ We recently completed a huge build-up job on a die for the Murray Body Corp., Detroit, in connection with a design change on the 1939 Model Ford front fender. This die weighed 15 tons and comprised three pieces —two rings and one punch. The area built up ranged from 6 to 10 in. in width and in certain spots was built up to 4 in. above the original casting. The length of the built up area was 6½ ft.

About 900 lbs. of cast-iron rod (⅜ in. and ½ in.) was used in making this repair. The job consumed 60 tanks of oxygen, 48 tanks of acetylene, and 10 cans of cast-iron flux. Total labor hours exceeded 160.

These fender forming dies are too heavy to preheat. With a welder and helper, we used two large oxy-acetylene torches simultaneously. When the casting was hot enough to weld, the helper removed one torch and devoted his time to checking regulators and changing tanks. About 6 in. of weld was put down at one time and then the welding operation was stopped for several minutes to permit peening the weld metal.

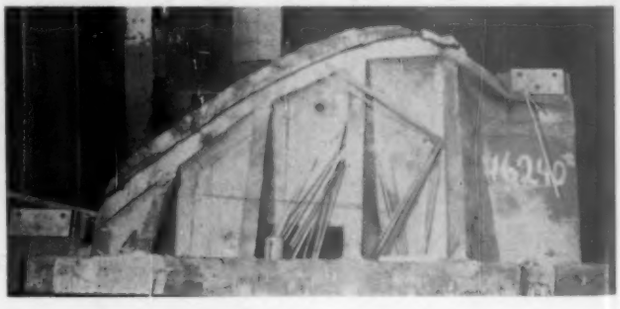
About 900 lbs. of cast-iron rod was used in building up this huge die.

Peening of cast-iron, while it may sound rather foolish, did help quite a bit according to our experience. We welded two of these large dies and one of them we did not peen, the other one we did. The one that was not peened developed more surface cracks than the other. However, these particular cracks were not serious and did not impair the operation of the die in any way.

Where small cracks appear on a drawing surface of a die they may scratch the stamping. In such a case it is necessary to vee out the crack and arc weld with a Nico electrode.

» «

"STEEL" OPENS NEW IRVIN WORKS—Prominent industrial and commercial leaders walked nearly 5 miles in an inspection tour which was a feature of the formal opening of Carnegie-Illinois Steel Corp.'s new Irvin Works, near Clairton, Pa. The plant, known as "the mill on the hill," is a major project in the United States Steel Corp. modernization program in the Pittsburgh District.

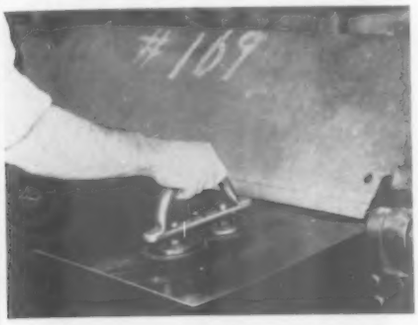


Side view of Ford fender die. Note extent of built up area.

New Product Developments

Eveready Lifters for Sheet Metal

★ Illustrated below is one of 5 models of "Eveready Lifters" which have been placed on the market by The Bastian-Blessing Co., 242 E. Ontario St., Chicago. These units are aimed to help manufacturers who are seeking a faster and safer method of handling sheet metals, sheet glass, or any product that has a smooth, non-porous surface.



Eveready Lifters employ huge rubber vacuum cups.

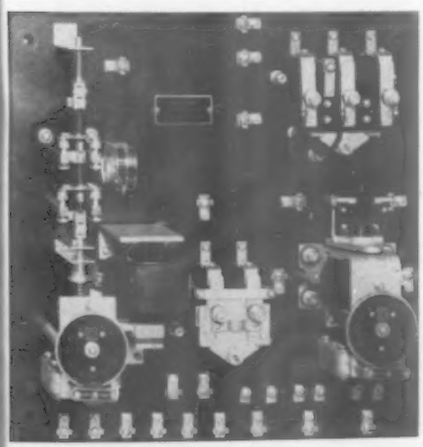
These lifters are of patented design, incorporating giant rubber vacuum cups which are provided with automatic releases that work with the flick of a finger. All parts are sturdily constructed, fully tested and guaranteed. The vacuum cups, which can be replaced in less than 5 min. without use of special tools, are the only parts which are subjected to wear. It is stated that this replacement cost is nominal.

Eveready Lifters are available in 5 models, 2 for light work, 2 for medium work and 1 for heavy lifting.

» «

Automatic Control Panel For Weld Timing

★ The control panel shown below is representative of a new line of fully automatic "repeat" and "non-repeat" weld timers for controlling air-operated, resistance welding machines. Built in accordance with proposed engineering standards, the various units involved perform one or all of the following functions: (1) Energize the solenoid valve which applies air pressure and closes the electrodes of the welding machine. (2) Supplies power to the welding transformer after sufficient pressure is on the work. (3) Interrupts power circuit after a pre-determined welding period. (4) Opens electrodes an adjustable time later. (5) Finally closes electrode again after a suitable interval, if repeat operation is involved.



Automatic timer panel for resistance welding.

Once a cycle of operation is started, it cannot be interrupted until it ends. The operator is relieved of all responsibility, with exception of moving work or tool to a new location for another weld. All timing periods are independently adjusted and indicating dials, calibrated directly in cycles, are provided.

A low-voltage power supply for the push button is optional. A timing unit can be added to any one of the panels, to make the use of a pressure switch unnecessary. All of the equipment is mounted on an ebony asbestos panel and enclosed in a heavy gauge, sheet steel cabinet. For additional information, write to the Square D Company, Industrial Controller Division, 710 So. Third St., Milwaukee, Wis.

» «

Busch "Metaphot" for Metallurgical Testing

★ The George Scherr Co., 128 Lafayette St., New York City, announces the Busch "Metaphot" a metallurgical microscope of new design. It is a combination of microscope and photographic camera assembled into one permanently aligned unit. Instead of bellows the camera is equipped with the new patented "Vario-Ocular," a device which changes the magnification of any eyepiece optically at the turn of a dial. By this means the ground glass remains always in the same fixed position right in front of the observer permitting a continuous series of definite magnifications where needed. Exactly 100 diameters for grain size estimations or examinations of inclusions in steel are afforded. Other standard magnifications of 200, 500, 1000, 2000 diameters can also be obtained.

New metallurgical microscope.

The "Metaphot" is designed to meet the requirements of the shop and testing room, taking less desk space than a typewriter, is shock and dust proof and needs only minor adjustments when pictures have to be taken. The lamp house can be tilted for inspection of machined or finished surfaces. The stage of the microscope is of the inverted type. It accommodates polished or fractured specimens of any size or shape. The type of illumination can be changed instantly from bright field to dark field, vertical or oblique illumination.

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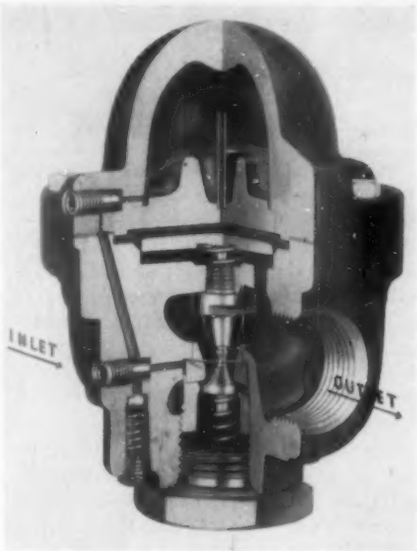


Grove pressure regulator has a permanent adjustment of pressure, which never needs resetting.

Grove Air and Gas Automatic Pressure Regulator

★ A new air and gas pressure regulator of unique design has been introduced by the Grove Regulator Co., 1729 Poplar St., Oakland, Calif. It is made in several sizes up to 6,000 lbs. per sq. in. High sensitivity, smooth pressure control, noiseless and chatter-proof operation are among its advantages, it is stated.

Use is made of an air dome valve motivator which is pre-charged to the desired outlet pressure and needs no further manipulation to hold a constant outlet pressure. This is said to effect sizeable improvement in welding torch heat control. The Grove regulator uses no springs or counterweights to load the diaphragm. It is said to overcome erratic valve movements by means of a special "Boyle" power chamber.

A 24-page illustrated bulletin may be secured by writing to the manufacturer.

Chicago Subway Gets Started

(Continued from page 32)

welding. Owing to the size of the columns and the constant presence of water dripping down the walls of the shaft, it was necessary to employ a lot of heat to overcome the chilling effect, which was further accentuated by the fact that the steel plates were butted against the damp earth.

The difficulties encountered at this point are illustrated, showing the welders perched in "Bowswains chairs" hung on ropes suspended from the top of the shaft. Approximately two hours before commencement of the structural welding the weather changed quite suddenly. The temperature dropped from approximately 45 deg. above zero to 6 deg. below zero, which still further accentuated the difficulties which the contractor and his men were called upon to overcome.

The oxygen and acetylene cylinders were both manifolded with standard Rego cylinder manifolds and two-stage RegOlators. All the preliminary welding and cutting work was done under the supervision of Bert Major, sales engineer for The Bastian-Blessing Co.

News of the Industry

1938 Editorial Index

Readers who desire an index of the major articles which appeared in the twelve issues of The Welding Engineer during 1938 may obtain one by writing to the editor.

OUTLOOK FOR 1939—The business outlook for 1939 and the accomplishments for the year 1938 were outlined in formal statements by two of the leading manufacturers of electrical equipment. Here is a statement issued by GERARD SWOPE, president of General Electric Co.:

"We in the General Electric Co. look forward with confidence to a better year in 1939 than 1938. With closer co-operation between labor, industry and the government; with the ever-increasing use of electricity; with the great need that exists in this country today for electric appliances in the home and for more power in the factories and the resulting expansion of generating capacity in central stations—all this will mean increased opportunities for production of the heavier capital goods, so much needed at this time by thousands of skilled workmen, not only in the electrical industry, but all industry, and for the good of the entire economic system."

The following statement was issued by GEORGE H. BUCHER, president of Westinghouse Electric & Mfg. Co.:

"The year 1938, though not a big year as far as business is concerned, was notable for important strides in research and engineering. In the electrical field, it witnessed the introduction or wider use of such contributions as the sterilizing lamp, which opens up new possibilities in the control of bacteria, moulds and diseases; the electrical dust precipitator, which makes it possible for the first time to clean air by electricity with thoroughness; topping turbines and hydrogen-cooled generators which increase the efficiency of power houses; advances in the study of nuclear physics, which promise important new knowledge about the structure of matter; and many other major advances, including new developments in metallurgy and insulation.

"If general business becomes better during 1939, the electrical industry is in excellent position to measure up to its opportunities. The possibilities of electricity as a servant of industry and humanity are only beginning to be realized."

» «

ALLIED WELD-CRAFT, INC., Indianapolis, Ind., is a newly organized independent company (Indiana corporation). Incorporators are PAUL B. HALL, who has served as manager of welding sales and manager of Welding Division of the J. D. Adams Co.; EDMUND L. PELTIER, who has been associated with metal working machine tool sales for many years and is president of the STATE MACHINERY CO., INC., of Indianapolis; DONALD C. PIPPEL, who has been associated with J. D. Adams Co. for a number of years as sales engineer in the Welding Division.

This new company is successor in all respects to the Welding Division of J. D. Adams Co., including manufacturing rights, patents, going business and good will. This company afforded a large proving ground which permitted development of quality products. With this background and technical staff, the new company expects to enter into active promotion of all types of electrodes. Special development and promotion will be applied to the stainless, alloy, and hard-surfacing field. The entire welding sales organization of the old company is retained by the new company.

As soon as alterations can be completed, the new company's factory and offices will be located at 601 to 637 Kentucky Ave., Indianapolis, Ind.

Personals

JOHN B. AUSTIN, research engineer on arc welding and active in metallurgical circles, has become associated with REPUBLIC WELDING AND FLAME CUTTING CO., a division of CONSOLIDATED IRON-STEEL MFG. CO., 1290 East 53rd St., Cleveland, Ohio. It is stated that Mr. Austin's contributions to the progress of arc welding include 22 patents on welding developments or processes resulting from his efforts in non-ferrous and ferrous metals.

Not long after his graduation from the

JOHN B. AUSTIN

University of Pennsylvania (School of Engineering) in 1921, Mr. Austin devoted himself to the development of a process of attaching copper bonds to steel rails. Soon thereafter he became engaged with others in solving one of the most difficult welding problems of the time, the welding of rail joints in urban electric railway track systems. The alloy-coated electrode then developed lifted the process to a point where the life of the welded joint equaled that of the rail.

As industrial welding grew in importance, Mr. Austin is said to have aided in the creation of most of the principal types of both light and heavily-covered rods for automatic and manual arc welding.

» «

FRANCIS HODGKINSON—The Holley Medal of The American Society of Mechanical Engineers has been awarded to FRANCIS HODGKINSON, honorary professor of mechanical engineering at Columbia University and former associate of George Westinghouse, for "meritorious services in the development of the steam turbine." The award was made during A.S.M.E. "Honors Night" ceremonies at the Engineering Societies Building, 29 West 39th St., New York City.

Mr. Hodgkinson is said to have contributed more to the evolution of the steam turbine than any other one man, and is an outstanding figure in the engineering profession. He retired as consulting mechanical engineer of Westinghouse Electric after 40 years of service in February, 1936.

HARRY M. FRANCIS has been appointed assistant vice-president in charge of sales of the AMERICAN STEEL & WIRE CO., subsidiary of UNITED STATES STEEL CORP. Mr. Francis has been associated with the Wire Company for 23 years, having entered its employ as a messenger in the New York office in 1915 and later becoming a salesman. After serv-

HARRY M. FRANCIS

ing as assistant manager of sales at the Philadelphia office, Mr. Francis returned to New York in 1925, and in 1927 was transferred to the Boston office as manager of the manufacturers trade department. In 1934 he became New England district manager of sales, which position he retained until being transferred to the main offices in Cleveland as assistant general manager of sales.

» «

R. M. ALVORD, J. E. N. HUME and A. S. MOODY have been appointed commercial vice-presidents of the General Electric Co. Mr. Alvord is manager of General Electric's Pacific District, consisting of California, Arizona and Western Nevada. Mr. Hume has been manager of the Industrial Department of the General Electric Company since December, 1935. Mr. Moody has been manager of the Northwest District of the company since 1936, prior to which he was manager of the Northwestern territory.

A.W.S. Activities

LOS ANGELES SECTION, A.W.S. held its annual Stag Party on Thursday evening, December 15, 1938, in the Commercial Club Bldg., 11th and Broadway, Los Angeles. It was evident from the announcement of the meeting that the Spanish influence in music and dancing predominated.

» «

MILWAUKEE SECTION, A.W.S. — "Cutting and Welding in Ship Construction" was the subject of a talk by L. B. OLSEN and ROBERT KING, welding supervisors for the Manitowoc Ship Building Co., Manitowoc, Wis. Their talk was well illustrated and covered oxy-acetylene flame cutting and arc welding procedures employed in ship construction.

» «

PHILADELPHIA SECTION, A.W.S. — "New Applications of Gas Welding" was the subject of the January 16th meeting held at the Engineers' Club

» «

CLEVELAND SECTION, A.W.S.—"New Developments in Cutting and Flame Hardening" was the subject of a talk by Dr. Geo. V. Slottman of Air Reduction Sales Co. at the meeting held January 11th in Bingham Hall, of Case School of Applied Science.

» «

OKLAHOMA CITY SECTION, A.W.S.—At the December 6th meeting held at the Huckins Hotel, the Section entertained HARRY C. BOARDMAN, National President of A.W.S. Mr. Boardman covered qualification rules and welding research. He also pointed out the program, which is under way for the purpose of simplifying and tying together the many existing codes dealing with welded fabrication. At the conclusion of his talk Mr. Boardman was presented with a speaker's gavel, suitably engraved with the Society emblem, name of Section, and of course the name of recipient. K. B. BANKS of the Oklahoma City Section made the presentation.

» «

SAN FRANCISCO SECTION, A.W.S. — The Section held its December meeting on the 20th at the Richmond refinery of Standard Oil Co. of Calif. Fifteen-minute talks were made by members of the oil company personnel. Subjects covered were: Training and Qualifications of Welders; Checking Design of Welds; Inspection of Welds; Testing of Welding Rods and Welding Methods; and Corrosion and Other Failures of Welds. The talks were illustrated with slides. In addition to these talks, there was a demonstration of testing equipment by W. J. JACKEL. Chairman N. F. WARD presided.

» «

SAN JOAQUIN VALLEY SECTION, A.W.S.—Subjects featured at the December 15th meeting of the Section were, "Welding Requirements Under Order 813E, Boiler Safety Orders of the State of California" and "Requirements for Welding under Order U-69, A.S.M.E. Code." These subjects were covered by F. W. CHURCH, engineer, of the Fidelity and Casualty Co., New York City. Following Mr. Church was a paper by J. E. BEEBE, welding engineer for the Hancock-Bush Oil Co., of Santa Maria. His subject was, "Field Welding of Rotary Drill Pipe." Mr. Beebe's paper was illustrated with a number of slides taken from photos of actual operations involved during welding of pipe. Through use of models, he illustrated certain specific details of welding operations, which are of paramount importance. Meeting was held at the American Legion Hall, 600 D St., Taft Heights, in Taft. Chairman J. W. STEEN presided.

Future Meetings

January 23-27, 1939

American Institute of Electrical Engineers, 33 W. 39th St., New York City.
Annual Winter Convention in New York City.

February 23-25, 1939

American Society of Mechanical Engineers, 29 West 39th St., New York City.
Spring Meeting at New Orleans, La.

March 8-10, 1939

International Acetylene Association, 30 E. 42nd Street, New York City.
Thirty-ninth annual convention will be held at the Rice Hotel, Houston, Texas. Complete program announcement will be carried in the February, 1939, issue.

April 17-19, 1939

American Institute of Electrical Engineers, 33 West 39 St., New York City.
Southwest District Meeting at Houston, Texas.

Trade News

THE INDUSTRIAL DIVISION of RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., builders of an adjustable welding work table and positioner, have appointed MACHINERY AND WELDER CORP., 1474 S. Vandeventer Ave., St. Louis, Mo., exclusive representative in the states of Illinois, Missouri, Kansas and parts of Indiana, Iowa, Wisconsin, and Michigan.

» «

R. H. MCGREDY, for many years a sales executive of the Harnischfeger Corp., Milwaukee, Wis., has been appointed manager of the Harnischfeger Washington office. Mr. McGredy is now residing at R.F.D. No. 1 in Alexandria, Va.

» «

THE HARNISCHFEGER CORP., Milwaukee, Wis., announces the appointment of the BUTTE TRACTOR AND EQUIPMENT CO., located at Redding, Calif., as exclusive agents for P&H-Hansen arc welders and Smooth-arc welding electrodes. The new distributor will operate under the supervision of the Harnischfeger San Francisco office.

» «

W. J. CHESAK has severed his connection with the Car Parts Depot, welding supply jobbers of El Paso, Texas. His financial interest was sold to A. E. GRAVES, president, and BASIL RYAN, secretary-treasurer of the company. Mr. Chesak has been identified with this jobbing firm since 1933. He will be succeeded by JACK JENNINGS, formerly of the El Paso Refining Co., a local oxygen manufacturer.

» «

WESTINGHOUSE STARTS OVERTIME PAYMENT —Anticipating by 3 years the final provision of the Labor Standards Act, the Westinghouse Electric & Mfg. Co. will begin paying

Ryerson a dependable source for Welding Rod

● Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

Ryerson
Shielded Arc Type
No. 215
Shielded Arc Type
No. 216
Shielded Arc Type
No. 217
Green Processed No. 18
Copper Coated No. 206
Copper Coated No. 210
Cast Iron

ELECTRODES
Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux Coated
Blue Flux Coated

GAS RODS
3½% Nickel Steel
High Carbon Bare
No. 2110

Ryerson
3½% Nickel Steel Flux Coated
High Manganese Steel
Hard Surfacing
Allegheny Stainless Flux Coated
Allegheny Stainless No. 44

Tobin Bronze
Allegheny Stainless Bare
Hard Filler

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

overtime immediately to all salaried non-exempt employes working in excess of 40 hours a week. GEORGE H. BUCHER, president of the company, estimated that about 12,000 salaried employes will be benefitted by the decision. The plan will be made retroactive to October 24, 1938, when the Act went into effect.

» «

FRANK P. SNYDER has been appointed sales representative for The Alexander Milburn Co., with headquarters in Detroit, Mich. Mr. Snyder was formerly sales engineer for the De Vilbiss Co.

Foreign News

EUROPEAN WELDING PRACTICE

CHARLES H. JENNINGS, engineer in charge of welding research for Westinghouse Electric & Mfg. Co., reviewed the welding practices in European countries, and present American trends, in a paper presented at the annual convention of the Association of Iron and Steel Engineers. Following is a condensed abstract of Mr. Jennings' paper:

Welding in Europe has grown to be as important a tool in engineering as it is in the United States. Welding machines in Europe are of high quality and in most European countries the use of a-c. equipment surpasses the use of d-c. equipment. Special attention has been directed to low-rating machines for thin gauge welding with the consequence that excellent a-c. and rectifier type sets have been developed for this work.

Welding electrodes in Europe are primarily of the shielded-arc type, although considerable quantities of bare and light dipped electrodes are still in use in Germany and France. Spot and other types of resistance welding are not in as common use as in America. There is a great interest in this method of welding, however, particularly for automobile, aircraft and railway construction. Auto manufacturers are at present considering installation of tube-controlled equipment for production of duraluminum bodies.

Gas welding, cutting and brazing are in common use and very high grade results are being obtained on all types of metals. The industries in which welding is being used compare with those in the United States. Ships, buildings, bridges, railway coaches, autos, buses, elevators, pressure vessels, and all engineering equipment are now being fabricated by welding. Although welding is used in nearly every field of engineering, future possibilities both in Europe and America indicate that its development in the future will be even greater than in the past.

Current Reviews

THE TORSION TEST was the subject of the 1938 A.S.T.M. Edgar Marburg lecture delivered by Dr. Albert Sauveur. Following general discussion of the test, there is described the torsion machine, test specimens, and results of tests on various materials. This is followed by information and data on tests at elevated temperatures, twisting in the blue-heat range, reverse twisting, and torsion of single crystals. The lecture has been published in pamphlet form and copies can be obtained from American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., at 35c per copy.

» «

THE SYMPOSIUM ON IMPACT TESTING, held at the 1938 A.S.T.M. annual meeting, concentrated on two important phases of the subject; first, the present fields of commercial use for the impact test with particular reference to places where it gives necessary information not supplied by static tests, and second, the basic theory of the test. Nine extensive technical papers and discussions comprise the 170-page symposium book.

Practical application of the notched-bar impact test, and use of the Charpy test as a method of evaluating toughness adjacent to welds are covered in separate papers, followed by data on stress-strain relations under tension impact loading and a discussion

The Improved "Round File" Gas Lighter

Large File Area

The "Round File" construction provides a very large file area — *approximately one square inch.* This assures longer life for the lighter. The file is of superior quality and can be easily replaced.

Many superior design and construction features combine to make the Improved "Round File" the most economical and efficient lighter on the market. Get acquainted with Improved "Round File" and its many advantages.

Circular and prices on request.

SAFETY GAS LIGHTER CO. (Est. 1901) **LYNN, MASS.**

of the theory of impact testing. There are some general considerations on the impact testing problems; and a review of the literature on impact testing of welded joints.

The publication contains a great deal of technical information and data in the form of tables and charts. Copies in heavy paper cover are available from American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., at $1.25 per copy.

Recent Patents

Direct Current Welding

2,139,160. Edward S. Hebeler, Williamsville, N. Y. Filed April 30, 1936. Issued Dec. 6, 1938. In the welding of metals by direct current, a method of stabilizing the arc is provided, which includes a method of creating and maintaining a continuous pulsating uni-directional flow of electricity through the welding electrode.

» «

Welding Electrode

2,138,388. Henry T. Platz, Detroit, Mich., assigned to Briggs Mfg. Co., Detroit, Mich. Filed Dec. 6, 1937. Issued Nov. 29, 1938. This invention has two objects. An electrode for resistance welding is provided which has a renewable tip which may be replaced after it is worn by use. The tip is so constructed as to have a projection which fits snugly within the central bore of the main portion of the electrode. A washer of phosphor-bronze is placed between the tip and the electrode body, and the point of junction is welded to secure a bonded joint. The tip is of a smaller diameter than the main electrode body. This permits visual inspection to indicate to the operator the remaining useful life of the tip is it wears away.

» «

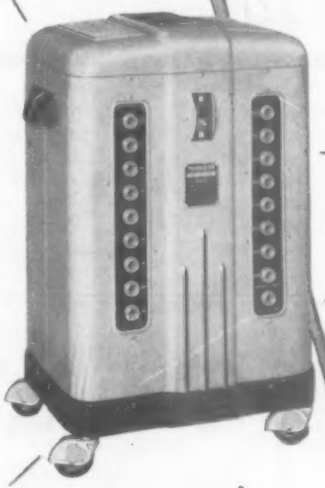
Filler Material for Welding

2,139,730. Joseph Ralph Dawson, Niagara Falls, N. Y., assigned to Oxweld Acetylene Co., West Virginia. Filed May 4, 1938. Issued Dec. 13, 1938. The patent relates to a filler material for welding and brazing. The material comprises 0.05% to 0.6% silicon; 0.05% to 0.3% phosphorus; manganese in an amount not exceeding 0.3%; and the remainder copper.

PAYS FOR ITSELF
FROM SAVINGS AND PROFITS

The MARQUETTE A.C. ARC WELDER

is more than paying for itself from the savings and profits on the first few jobs. Shops, factories and industrial plants from coast to coast find that the Marquette A.C. Arc Welder is the most profitable item they have.



- Three models at three prices . . . $155, $195 and $225.
- Alternating current automatically reverses polarity 60 times a second, puddling molten metal for strong, dense, ductile welds.
- Listed by Underwriters' Laboratories, Inc.
- Amperage range: 20 to 150 amps., 20 to 200 and 20 to 250.
- Welds thin sheet metal, fenders, bodies, etc., to the heaviest of steel beams, castings and motor blocks.
- Fully equipped with cables, electrode holder, helmet and an assortment of electrodes.

UL Marquette A. C. Arc Welders are listed by Underwriters' Laboratories, Inc.

For complete information write:

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MINNEAPOLIS, MINNESOTA

"FALCON" ELECTRIC PREHEATING AND STRESS RELIEVING HEATERS . . .

for welding pressure piping including nozzles, valves, fittings, etc.

Illustration shows position of two coil type wrap-around heaters for preheating while welding 8" pipe to Series 1500 valve neck, using multiple point automatic temperature control. *Heat available at all times during welding permitting deposit of best quality of metal without interruption.*

A third coil is added over welding space to raise joint to stress relieving temperature. Heating cycle complete from start to finish without removal or replacement of units.

Blanket type insulation provided over heaters during operations for heat conservation.

SOLID CLAMP-TYPE HEATERS also available for maximum temperatures up to 1850°F.

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QUOTATIONS GLADLY FURNISHED
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SAVE... by welding

Jaw Plates, Gyratory and Roll Crushers, Shovel Teeth, Hammers, Tractor Tread Grousers, etc., with

Manganal 11 to 13% Nickel Manganese Steel

U. S. Patents 1,876,738 1,947,167 and 2,021,945

WELDING ELECTRODES
WEDGE and APPLICATOR BARS
Hot Rolled PLATES

Write for name of nearest distributor

STULZ-SICKLES CO. Sole Producers **91 N. J. Railroad Avenue, NEWARK, N. J.**

If not acquainted with SEACO HARD-SURFACING WELDING ELECTRODES, write today for descriptive circular.

Composite Welding Rod

2,137,471. John A. Zublin, Los Angeles, Calif. Filed Dec. 10, 1937. Issued Nov. 22, 1938. This patent relates to a welding rod containing individual hard pure metallic carbide pieces adapted to be welded to an iron body. The rod also includes a substantially pure non-carbon absorbing metal, in close proximity to the carbide pieces, but not adhering to them. The metal protects the carbide pieces during the welding operation, against chemical decomposition or alloying with the iron body, by flowing of the non-carbon absorbing metal around the individual carbide pieces.

» «

Flame Machining and Welding Method

2,137,801. Frank C. Geibig, Westfield, and Wilgot J. Jacobsson, Elizabeth, N. J., assigned to Union Carbide and Carbon Corp., New York. Filed Jan. 12, 1935. Issued Nov. 22, 1938. To form a groove at a seam of two adjacent metal bodies it has been the practice to hold an oxidizing flame at an acute angle to the axis of the groove being cut. The patent points out that this method is wasteful of the oxidizing gas and produces an irregular cut. The improved method involves the application of the gas stream from a blow torch, progressively in the direction of the groove, while maintaining the axis of the stream, adjacent to its point of issue from the nozzle, substantially parallel to the groove axis, but below the surface of the metal body and near the bottom of the groove.

» «

Initiating a Welding Arc

2,138,025. John D. Crecca and Samuel S. Scott, St. Albans, N. Y. Filed Jan. 13, 1934. Issued Nov. 29, 1938. A composition is provided which eliminates the necessity of first contacting a welding electrode with the work to be welded to strike an arc. The material comprises two parts of steel chippings and one part of aluminum filings. A small quantity of this material is placed upon a plate to which a body, such as a stud, is to be welded. The material causes immediate arcing when the circuit is closed. This composition has particular utility in welding two bodies, one of which is of relatively small cross sectional area on the surface to be joined, as compared with the other metal body. The process is suitable, for example, in stud welding.

Trade Literature

Cold Weather Care of Acetylene Equipment—This is the subject of a 40-page book, published by The Linde Air Products Co., containing suggestions for proper maintenance of acetylene generators and associated equipment subject to freezing.

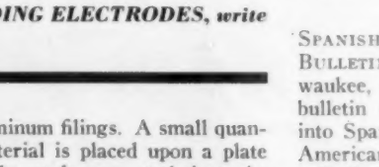
This book explains how to prevent freezing of acetylene generators, hydraulic back-pressure valves, distribution piping and hose, regulators, relief valves, and water-cooled blowpipes. Also contains suggestions for procedures where freezing has occurred. Copies may be obtained from The Linde Air Products Co., 205 East 42nd St., New York City.

» «

Spanish Edition of Smootharc Electrode Bulletin—The Harnischfeger Corp., Milwaukee, Wis., announces translation of its bulletin on Smootharc welding electrodes into Spanish, for use in Central and South American Countries.

Bulletin R-5E is a complete manual of welding electrode information, including explanation of the welding action of the electrode and descriptions of many standard types of Smootharc welding electrodes. Ex-

DOUBLE WILLSON



Style RW 50

Welding Goggles

Meet Federal Standards

FOR ALL TYPES OF WELDING

Maximum Eye Protection Assured!

WILLSON WELDING GOGGLES not only meet rigid Government Specifications for Safety but they assure the utmost in Comfort and Durability in service.

Style RW 50, illustrated above, employs 50 mm. WILLSON-WELD Filter Lenses and 50 mm. clear cover lenses. The composition eye cups are anatomically shaped to fit over the orbital cavity and are heat and moisture proof. Patented indirect ventilating ports assure ample flow of air but exclude injurious light flashes, sparks, etc.

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Let a Willson Safety Service Representative Make Recommendations Without Obligation!

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GOGGLES RESPIRATORS HELMETS

amples of tensile tests of electrodes are given, as well as "spark tests" in graphic black and white illustrations, to enable even inexperienced welders to determine the type of metal upon which they are welding and the type of electrode more suitable for the work.

Copies of this bulletin may be obtained by writing to Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.

» «

1939 Black & Decker Catalog—The 1939 Black & Decker catalog, now ready for distribution, features a complete line of portable electric tools and accessories. This new catalog comprises 56 pages and cover, attractively displaying the line. Many new improvements in design and construction have been incorporated into many of the familiar units in the line and a number of new tools have been added.

Three new units make their appearance for the first time in this catalog. On page 1, is the new 3/16 in. Hornet Drill, a small and lightweight production drill. On page 5, is the new 5/16 in. Ball Bearing Utility Drill. On page 29 is a new No. 36 Portable Electric Hammer.

For a copy of the new 1939 catalog, write to the Black & Decker Mfg. Co., Towson, Md.

» «

Smith Welding Equipment Corp., Minneapolis, Minn., has published a new catalog covering Smith's Silvertip welding electrodes and oxy-acetylene welding rods. This is a 16-page catalog covering 13 types of Silvertip electrodes and 13 types of oxy-acetylene welding rods.

» «

Dravo Corporation, Lee Heater Division, Pittsburgh, Pa., has recently published a bulletin describing their new suspended type unit heater for gas firing. This heater has the unusually large output of 500,000 b.t.u.'s per hour, which, combined with a high velocity, enable the heater to supply warm air to a large area. Copies of this bulletin will be sent free upon request.

» «

A. M. Byers Company General Catalog—This company has issued a consolidated general catalog, 1939 edition, covering standard specifications, dimensions and other essential information desired by the specifier and purchaser of tubular products. Page size is 8½ x 11 in. and catalog has a spiral wire binding. There is a very complete index for quick reference. 56 pages.

Obituary

Horace B. Spackman, retired vice president of Lukens Steel Co., Coatesville, Pa., died Sunday, December 11th, of a heart ailment, in his 77th year. In 1897, Mr. Spackman was elected a director of Lukens Steel Co. and served in that capacity until his death. He became a vice president in 1900 and served in that capacity until May 1, 1929, when he retired from active duty after more than 48 years of continuous service.

1. It provides high strength and *ductility*.

2. It gives high electrical conductivity.

3. Its low working temperature (1300° F) adds speed and protection to metals when brazing copper, brass and bronze.

Everyone, after using SIL-FOS, appreciates how little of this alloy you need to make a strong, ductile joint. They find that *low temperature SIL-FOS brazing is low cost brazing*, that application is fast, labor and material costs low and rejects no longer a problem.

If you do not use SIL-FOS, let us show you how it can be used to improve products and lower costs. Write for Bulletin 51-W.

Handy flux
For copper to copper joints SIL-FOS requires no flux—always use HANDY FLUX for other metals. Its low fluid temperature (1100° F) lets you take full advantage of the low flow point of SIL-FOS. Bulletin 9 gives details. Write for a copy.

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Classified Section

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FOR SALE—1900 ft. slightly used, practically new, rubber-covered super-flexible welding cable. No. 2 size for 200 amp. welders only 13c ft.; No. 1 size for 300 amp. 17c ft.; No. 1/0, 21c; No. 2/0, 25c. Metallizer gun $115, like new; 100 amp. Lincoln welder $100; 150 amp., $125; 200 amp., $160. Selling out over 40 units. Address Ja-4, The Welding Engineer.

FOR SALE—Several hundred 1800-2000 cu. ft. oxygen cylinders with, or without CO_2 valves. Cleaned and recently tested to 3000# hydrostatic. Guaranteed in good condition. Price F. O. B. Pittsburgh on request. Carbonic Gas Service Co., 1341 Liberty Ave., Pittsburgh, Pa.

BARGAINS—Demonstrator Arc Welders. Gasoline and Electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-19, Troy, Ohio.

FLY BALL GOVERNORS—Adapted to all makes of auto engines; belt driven, flat or V. Price $6.50 prepaid, Ball bearing $2.00 additional. Satisfaction guaranteed. In ordering state style of belt. Wm. Alber, Beatrice, Nebr.

FOR SALE — Complete low-priced welding and cutting outfits. Guaranteed. Soldering and brazing torches. Dependable repair service on all makes of equipment. Gasweld Equipment Co., 625 W. Jackson Blvd., Chicago, Ill.

FOR SALE—1000-amp. 75-volt, G.-E. Arc Welder direct connected to G.-E. 115 hp. polyphase motor, compensator, switchboard, 6 welding stations. Perfect condition, cost $5200. Sell $800. Carl A. Yard, Sea Girt, N. J.

WANTED TO BUY

RELIABLE JOB SHOP WELDER desires to invest his experience and capital in a small business. Address Ja-1, The Welding Engineer.

GREATER PROFITS THIS SPRING THAN EVER BEFORE

A new line of points and edges will bring your profits for 1939 to a new high. Shops all over the country are adopting this method daily. Aggressive shops use as high as 1,000 plow share units in a year. For spring you have plow shares, planter runners, cultivator shovels, sweeps, and other farm implements to reclaim at a profit. Cash in now. Write for new catalog.

U. S. Patents 2,013,818 and 2,051,234
Canadian Patents 365,296 and 369,723

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WIESE PLOW WELDING COMPANY
(Originally New Process Plow Welding Company)
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EISLER
A.C. ARC WELDERS and SPOT WELDERS
Sizes ½ to 500 KVA
Send samples for test—no obligation.

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HELP WANTED

SALESMEN—Calling on plants doing arc welding to sell welding cables, electrode holders, helmets, lenses, as sideline with big commission. Address Ja-5, The Welding Engineer.

POSITION WANTED

WELDING SPECIALIST—23 yrs. exp. on boilers under U-68 Code; heavy construction; high-pressure piping; 4 yrs. welding sales. Married. Desire sales or supervision connection, any locality. Address Ja-7, The Welding Engineer.

SALES ENGINEER—Desires position with aggressive going concern marketing electrodes, welding units, accessories and oxy-acetylene equipment. Can demonstrate and sell. Able to meet public. Free to travel. Address Ja-2, The Welding Engineer.

COMBINATION WELDER—Age 26, welding school graduate. 2 yrs. exp. in own shop. Prefer production work. Sheldon C. Heck, Lehigh, Iowa.

COMBINATION WELDER—Desires permanent connection with construction company, U. S. or foreign. References. Address Nov-4, The Welding Engineer.

ARC WELDER—2 yrs. exp. all positions, graduate Hobart Welding School. Age 24, married. Willing go anywhere in U. S. Verl C. Lontz, 103 E. Graham St., Kentland, Ind.

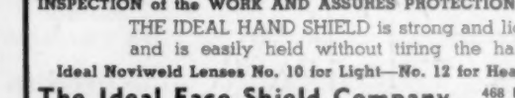
COMBINATION MTCE. WELDER—28 yrs. old, 3½ yrs. exp. on mtce. welding. Will go anywhere. Prefer So. America or Australia. Joe J. Turkal, P. O. Box 404, Bessemer, Mich.

ARC WELDER—Age 28. 2 yrs. limited exp. Willing go anywhere. Hollup and Armour Institute trained. First consideration opportunity to obtain exp. James T. Laughlin, 1548 E. 65th Pl., Chicago, Ill.

COMBINATION WELDER—With complete welding equipment on truck, new G-E 300 amp. gas-driven welder. Would like connection with construction co., or any work allowing good part of time outside, preferably Rocky Mt. region. Age 40. Address Ja-3, The Welding Engineer.

WELDER—6 yrs. exp. in gas and electric welding, desires position in sales and service. Salary secondary. Age 28, married. George J. Chlebicki, 14,810 Robey St., Harvey, Ill.

THE IDEAL HELMET FOR WELDING
protects the head, chest and neck from direct and reflected rays
THE HELMET WITH A DOOR GIVES CONVENIENCE FOR QUICK INSPECTION of the WORK AND ASSURES PROTECTION for the EYES
THE IDEAL HAND SHIELD is strong and light and is easily held without tiring the hand.
Ideal Noviweld Lenses No. 10 for Light—No. 12 for Heavy Welding
The Ideal Face Shield Company 468 N. Garfield Ave. Columbus, Ohio



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WHITE METAL (DIE CAST) "POT METAL" IS EASILY AND QUICKLY WELDED with Aladdin Rod at a profit. Don't continue to lose profit by turning down White Metal parts. Only Aladdin Rod is guaranteed to produce welds of greater tensile strength than original metal. UNEXCELLED AS AN ALUMINUM SOLDER. Directions with each pound. If your jobber cannot supply you, order direct. Sizes. ⅛-3/16-¼.

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P. O. BOX 985, MADISON SQUARE STATION GRAND RAPIDS, MICH.

New Technical Literature

We have listed on this page brief reviews of new technical literature prepared by experts in the employ of welding equipment manufacturers. Any literature you may desire will be sent to you free of charge. Merely check or mark serial number of paragraph on order blank at bottom of page. No obligation.

Brazing Carbide Tool Tips

(70) Handy & Harman have a bulletin detailing procedure to follow in brazing cemented carbide tool tips to holders. Claim is made that this job has been simplified and speeded up by the use of Easy-Flo No. 3 brazing alloy. This alloy has a medium silver content. Simple sketches clearly outline the correct procedure.

Twinweld Rubber Hose

(71) Hewitt Rubber Corp., has a small pictorial folder sketching the applications and practical advantages of Twinweld welding hose. Two lines of oxy-acetylene hose molded into one hose. Available in continuous lengths up to 500 ft.

Lining for Skullgard Hats

(72) Single page bulletin describes the M.S.A. Winter Lining for men who wear Skullgard head protection on winter jobs. Insertion or removal of lining may be accomplished in quick fashion by use of snap fasteners. Proof against wind, snow or rain.

Alternarc A-C. Welders

(73) Electric Arc Cutting & Welding Co. has issued a two page bulletin covering a diversity of applications of its line of Alternarc a-c. welders. It is stated that these units can do electrical preheating and normalizing work as well as welding. Also suggested for "submerged arc" welding, cable soldering and bus-bar brazing.

Spot Welders

(74) A 4-page folder illustrates numerous types of Eisler spot welders. A complete line of spot welding machines for all weldable metals. Manually operated, air operated, motor operated and with variable speed drive where needed.

Nemco Weld Filler

(75) Northeast Metals Co., has a circular and sample available of Nemco Weld Filler for making arc welds on cast iron water tight. Claimed that this product is not affected by boiling water, gas oil or antifreeze solutions. Recommended for motor blocks, heads, boiler sections, etc.

Acetylene Cylinders

(76) "What Goes in the Bottle" is the title of a technical bulletin on acetylene cylinders issued by Independent Engineering Co. Contains information on testing of acetylene cylinders to meet the stringent regulations of the Bureau of Explosives of the I.C.C. Several good photographs are included.

Welder Control Catalog

(77) Square D Co. has a new catalog containing complete descriptive information of its line of welding control devices for nearly all types of resistance welding machines. Designs are based on recently proposed engineering standards for this class of equipment. Contains rating curves to assist the user in selecting contactors for a resistance welder.

Anaconda Welding Rods

(78) This technical booklet gives a general description of bronze welding by the oxy-acetylene, metallic arc, and carbon arc processes. Contains specific suggestions for welding with each of the 16 standard Anaconda welding rods. Includes melting points and other helpful technical data.

Steel Conditioning

(79) The Airco process of steel conditioning with the oxy-acetylene de-seaming torch is covered fully in a new 22-page booklet. With increasing demands of users for steels of exceptionally high quality and surface finish, steel producers generally have come to regard torch de-seaming as the answer to the steel conditioning problem. Of major interest to men in the steel industry.

Welding Silicon Bronze

(80) Revere Copper & Brass, Inc., has available a reprint of an article entitled "The Carbon Arc Welding of Silicon Bronze." This reprint relates to an A.W.S. paper presented at the 1938 annual meeting.

Manganese Steel Welding

(8) Taylor-Wharton Iron and Steel Co. has available bulletins covering the welding of manganese steel and instructions for using Timang nickel manganese welding rod. Both of the bulletins on manganese steel welding were prepared by John Howe Hall, a well-known authority on metallurgy. Bulletin on Timang welding rod points out physical characteristics of welds made with this rod on high manganese steel castings.

Pneumatic Scaling Tool

(82) The Cleveland Pneumatic Tool Co. has issued Bulletin No. 84 describing the Type B-1 pneumatic scaling tool suitable for removal of weld splatter and excess weld metal in production welding. This tool can also be used for removing scale, for peening, and for cleaning rust and paint from metal surfaces.

A-C. Arc Welders

(83) A four-page bulletin issued by Will-Weld Mfg. Co., Inc., describes three different models of a-c. transformer type arc welders, including the "Blue Streak" and the "Zephyr 50" models. It is stated that welding current range of the "Blue Streak" extends from 10 to 130 amp.

Hampton Arc Welder

(84) A two-page circular describes the Model "E" Hampton transformer type a-c. welder rated from 20 to 280 amp. It is claimed to be suitable for electrodes from 1/16 to ¼ in. Continuous rating is claimed to be 150 amp.

Pierce Governor

(85) A 6-page folder is available describing the application of Pierce governors to internal combustion engines used for driving welding generators. Several applications are illustrated showing how these belt-driven Pierce governors are used.

A Fit-Over Goggle

(86) Sellstrom Mfg. Co. has a small folder describing its No. 225 Fit-Over Goggle designed for the man who must wear prescription glasses underneath his goggle. In this Sellstrom goggle a hinged frame is provided which permits the safety goggle to be pushed up out of line of vision without removing head band, and without disturbing regular eye glasses.

Portable Electric Tools

(87) The 1939 Black & Decker catalog of portable electric tools is now ready for distribution. This catalog features a complete line of portable tools and accessories. A number of new tools have been added to the line. 56 pages and cover.

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